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GEOLOGICAL SURVEY

# SELECTED WATER RESOURCES ABSTRACTS

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JUNE 1985

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# SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

# PREFACE

**Selected Water Resources Abstracts,** a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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# SELECTED WATER RESOURCES ABSTRACTS

## 2. WATER CYCLE

### 2A. General

**UNIT HYDROGRAPH BASED FORECAST MODEL,**
Indian Inst. of Tech., New Delhi. Dept. of Civil Engineering.
S. Chander, and H. Shanker.
Hydrological Sciences Journal, Vol. 29, No. 3, p 279-291, 1984. 5 Fig, 6 Tab, 4 Ref.

Descriptors: *Hydrologic models, *Storms, *Rainfall, Forecasting, Computers, Weather forecasting.

The unit hydrograph method is an accepted procedure for transforming rainfall excess or effective rainfall to obtain the time distribution of runoff for catchments that are usually less than 5000 sq m in area. This method has not been used for operational forecasting work because of the difficulty in estimating rainfall excess as the rainstorm progresses in time. A procedure is presented for on-line estimation of the Phi-index and rainfall excess as a storm progresses in time. Coupling this procedure with the unit hydrograph model can yield a procedure which will successfully allow real-time forecasting. Even in those storm events where the chosen unit hydrograph does not truly represent the response function, the forecasts have been found to be satisfactory. The forecasts deteriorate as lead time of the forecast increases partly because the assumption of no rainfall beyond the time of forecast is not valid in most of the events studied. (Baker-IVI)
W85-02827

**APPLICATION OF MATHEMATICAL MODELS TO LARGE AQUATIC ECOSYSTEMS,**
Hydrochemical Inst., Rostov-na-Donu (USSR).
A. M. Nikanorov, and W. R. Swain.
Journal of Great Lakes Research, Vol. 10, No. 3, p 235-239, 1984. 11 Ref.

Descriptors: *International agreements, *United States, *USSR, *Lake Baikal, *Saginaw Bay, *Sea of Azov, *Mathematical models, Model studies, Ecosystems, Lakes, Bays.

Within the framework of the US-USSR Joint Agreement on Environmental Protection, a stepwise progression of increasing complexity of mathematical modeling efforts has been used to identify specific problems, describe the parameters associated with each, understand the extent of the problem, and define alternative management scenarios for each individual situation. In this way, each succeeding step was built on the solid scientific findings of the previous study. This approach was used in a variety of circumstances to identify potential solutions to such diverse problems as transport and circulation patterns critical to planning development adjacent to a large ultra-oligotrophic ecosystem, definition of the transport of contaminants in a large eutrophic embayment essential to understanding the effects of remedial measures to control phosphate inputs, and definition of the range of measures that were potentially applicable to a hydrodynamic problem of saltwater intrusion which threatened to upset a well established ecological balance. It is clear that the mutual use of data-based mathematical modeling by participating nations as an instrument for systems analysis of large aquatic ecosystems has provided a series of solutions to a wide range of problems which would otherwise not have been available (Baker-IVI)
W85-02883

**SIMULATION MODELING AS A MEANS OF STUDYING LARGE AQUATIC ECOSYSTEMS,**
Rostovskii-na-Donu Gosudarstvennyi Univ. (USSR). Nauchno-Issledovatel'skii Inst. Mekhaniki i Prikladnoi Matematiki.
A. B. Gorstko, Y. A. Dombrovsky, A. A. Matveyev, J. F. Paul, and W. L. Richardson.
Journal of Great Lakes Research, Vol. 10, No. 3, p 240-244, 1984. 5 Fig, 3 Ref.

Descriptors: *Model studies, *Simulation, *USSR, *Lake Baikal, *Sea of Azov, *Mathematical models, *Water quality control, Fish management, Ecosystems.

The concept of simulation modeling of large aquatic ecosystems is discussed with special reference to a conceptual framework incorporating a series of sub-models. Development and application of the Sea of Azov and Lake Baikal models have seriously influenced the organization, planning, and research conducted on all levels of these ecosystems. The results of the models indicated shortcomings of prior investigations. Demands for experimental data have increased during the development of the models, making investigation in the fields of marine hydrology, hydrochemistry, and biology more complex and goal oriented. The broad application of reliable mathematical methods for synthesizing the results of field observations from the Sea of Azov and Lake Baikal was found to be invaluable. As a result of the efforts, the reliability of the scientific investigations have increased considerably. (Baker-IVI)
W85-02884

**ESTIMATION OF DAILY TEMPERATURE MEANS USING ELEVATION AND LATITUDE IN MOUNTAINOUS TERRAIN,**
Agricultural Research Service, Beckley, WV. Appalachian Soil and Water Conservation Research Lab.
D. G. Boyer.
Water Resources Bulletin, Vol. 20, No. 4, p 583-588, August, 1984. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Temperature, *Elevation, *Latitude, *Mountains, *West Virginia, Prediction, Mathematical models, Hydrologic budget, Model studies.

Temperature information is commonaly a primary component of water balance models; however, local temperature is often lacking. Most of the spatial variability of daily temperature means in the central Appalachian region can be accounted for by differences in elevation and latitude. A model was developed for predicting mean daily, mean daily minimum, and mean daily maximum temperatures in West Virginia. The model is easily used since the only inputs are elevation, latitude, and julian date. Since the input data are easily obtained, the model can be put to use quickly in a variety of resource management applications, including water budget modeling. With local calibration, the model is expected to apply to other areas in the Applachian region. (Moore-IVI)
W85-02986

**ESTABLISHMENT AND SURVIVAL OF WOODY RIPARIAN SPECIES ON GRAVEL BARS OF AN INTERMITTENT STREAM,**
California Univ., Berkeley. Dept. of Forestry and Resources Management.
J. R. McBride, and J. Strahan.
American Midland Naturalist, Vol. 112, No. 2, p 235-245, October, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Riparian vegetation, *Woody plants, *Gravel bars, *Dry Creek, *California, Seedlings, Sediment texture, Willow, Cottonwood, Baccharis, Drought, Scour, Sediment erosion, Vegetation establishment.

Factors influencing seedling establishment and survival were studied on gravel bars of lower Dry Creek, Sonoma Co., California. Gravel bars species became established from May to July. Seedling establishment was correlated with sediment texture. Salix spp. established preferentially on areas where surface sediment size was less than 0.2 cm. Populus fremontii established more densely of intermediate and large-sized sediments (0.2-1.0 cm). Baccharis viminea dominated on the larger sediment sizes. Drought-induced mortality of seedlings was highest on bars where the stream had dried up completely prior to 1 September 1981. The high winter flows of the 1981-1982 season scoured the sediments and killed the vast majority of remaining seedlings. Seedlings which established in areas protected from the swiftest current were, however, able to withstand the winter flows. At specific locations, changes of gravel bar landforms resulted in significant losses of established trees as well as young seedlings and saplings. (Author's abstract)
W85-03016

**STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF),**
National Weather Service, Portland, OR. Northwest River Forecast Center.
For primary bibliographic entry see Field 7C.
W85-03060

**SIMPLIFIED HYDROLOGICAL RAINFALL-RUNOFF MODEL,**
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Travaux Hydrauliques.
W. H. Hager.
Journal of Hydrology, Vol. 74, No. 1/2, p 151-170, October, 1984. 14 Fig, 1 Tab, 9 Ref, 2 Append.

Descriptors: *Rainfall-runoff relationships, *Hydrological models, Catchment area, Overland flow, Stream flow, Kinematic waves, Mathematical models, Rainfall intensity.

The rainfall-runoff process is investigated for relatively small catchment areas (< 100 sq km) and for heavy rainfalls. It is assumed that: (1) the rainfall excess nearly equals the effective rainfall; and (2) the rainfall intensity function depends on time alone and is single-peaked. The catchment area is approximated by two rectangular planes of not necessarily equal width but with constant bottom slopes and constant roughness factors. A small stream runs where the two planes intersect each other. Both the overland and the stream flow are assumed to be fully turbulent; they are modelled using the Manning-Strickler formula. Kinematic wave theory serves as the mathematical model to compute the hydrographs at an arbitrary location in terms of the prescribed, basic parameters. The solutions are displayed graphically, which allows direct determination of the solution sought. Variations in the average bottom slope and the average friction coefficient are found to have little influence on the resulting hydrograph. Rough estimates of these parameters suffice to obtain fair results. The model is tested by comparing observations collected in western Switzerland with present predictions. Agreement between the computed and the observed hydrographs is fair, given the simplicity of the described hydrological model. A step-by-step procedure with examples illustrate the method in detail. (Author's abstract)
W85-03088

**NEW GLOBAL ASSESSMENT OF THE STATUS AND TRENDS OF DESERTIFICATION,**
New South Wales Univ., Kensington (Australia). School of Geography.
J. A. Mabbutt.
Environmental Conservation, Vol. 11, No. 2, p 103-113, Summer, 1984. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *United Nations, *Desertification, Erosion control, Land use, Evaluation, Deserts, Arid lands, Dunes, Rangeland, Cropland, Irrigation, Salinization, Deforestation, Water supply.

An assessment of the status and trends of desertification was called for as part of a general assessment of progress in the implementation of the United Nations Plan of Action to Combat Desertification, seven years after the UN Conference on Desertification. Indicators of desertification include: growth and encroachment of mobile dunes and aeolian sand-sheets; deterioration of rangelands; degradation of rain-fed croplands; waterlogging and salinization of irrigated lands; deforestation and destruction of woody vegetation; and declining availability or quality of groundwater or surface-water supplies. Because of the inadequate data existing at the country or state level, the basic generalization has been set at a wider regional scale. The plan of action includes three components: assessment of the status and trend of desertification seven years after UNCOD, evaluation of progress in the implementation of the Plan of

Action to date, and an evaluation of the institutional and financial arrangements which supported the implementation of the plan. The first of these three parts is viewed in detail, including emphases on the defining of terms, global dimensions of the problem, regional impacts of desertification, desertification and land use, global trends, and projections to the year 2000. (Baker-IVI)
W85-03201

## 2B. Precipitation

**PRECIPITATION IN THE CENTRAL AMAZON BASIN: THE ISOTOPIC COMPOSITION OF RAIN AND ATMOSPHERIC MOISTURE AT BELEM AND MANAUS,**
E. Matsui, E. Salati, M. N. G. Ribeiro, C. M. Reis, and A. C. S. N. F. Tancredi.
Acta Amazonica, Vol. 13, No. 2, p 307-369, April, 1983. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Rainfall, *Belem, *Manaus, *Brazil, *Precipitation, Amazon Basin, Isotopic studies, Seasonal variation, Precipitation chemistry.

In order to improve the understanding of the water in the Amazon Basin, samples of rain and moisture were collected daily at Belem and Manaus from August 1978 to January 1980. All isotope data are presented. The most depleted values were encountered during the rainy season from January through April. During this season the events at Manaus closely followed those at Belem, on the average with a delay of a couple of days. This indicates the predominance of the east-to-west air motion, which sweeps across the basin from the Atlantic coast. The very low isotopic values have also been associated with the position of the ITCZ near the mouth of the Amazon. In spite of the isothermy of the area and lack of clearcut frontal systems, the data suggest that many of the rainy episodes are related to events imposed on the basin from outside and that only the winter period is predominantly influenced by the internal processes within the basin. Presumably then, winter is the season whose precipitation pattern would be most influenced by any deforestation program in the basin. (Baker-IVI)
W85-02816

**FREQUENCY DISTRIBUTIONS FOR DURATIONS AND VOLUMES OF RAINFALLS IN THE EASTERN UNITED STATES IN RELATION TO ACIDIC PRECIPITATION,**
Manhattan Coll., Bronx, NY. Lab. of Plant Morphogenesis.
L. S. Evans, G. S. Raynor, and D. M. A. Jones.
Water, Air, and Soil Pollution, Vol. 23, No. 2, p 187-195, August, 1984. 5 Fig, 1 Tab, 17 Ref. EPA contract IAG 81-D-X0533, DOE contract DE-AC02-76CH00016, and Associated Universities, Inc. contract 550925-S.

Descriptors: *Frequency distribution, *Rainfall, *Acid rain, *Long Island, *New York, *Seaside Park, *New Jersey, *Urbana, *Illinois, *Franklin, *North Carolina, *Coral Gables, *Florida, Acid precipitation, Chemical composition, Vegetation, Hydrogen ion concentration.

A significant percentage (between 17 and 40%) of all showers recorded on Long Island NY, Urbana, IL, Franklin, NC, and Seaside Park, NJ, had durations less than 20 min. Similarly, a large percentage had durations less than 40 min (50, 46, and 32% for 3 yr at Urbana, IL, 65% ar Coral Gables, FL, 50% at Franklin, NC and 54% at Seaside Park, NJ). When all data from the six growing seasons were pooled, over 88% of all rainfalls were less than 160 min. Similar results were observed when volume measurements were made. Between 38 and 57% of all recorded showers had less than 1 mm at all five stations in the eastern United States. When all data were pooled, over 65% of all rainfalls were less than 3 mm. These data demonstrate that plant foliage is wetted during the growing season by numerous showers which are of short duration and low volume. (Author's abstract)
W85-02926

**ESTIMATION OF PROBABLE MAXIMUM PRECIPITATION: CASE STUDIES,**
Harza Engineering Co., Chicago, IL.
B.-H. Wang.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1457-1472, October, 1984. 11 Fig, 4 Tab, 15 Ref.

Descriptors: *Probable maximum precipitation, *Precipitation, *Estimation, Depth-area-duration analysis, Statistical studies, Mathematical models, Hurricanes, Maximum probable floods.

The probable maximum precipitation (PMP) is the estimated precipitation depth for a given duration, drainage area and time of year for which there is virtually no risk of being exceeded. The PMP used in the probable maximum flood (PMF) analysis may be a generalized estimate taken from publications, or estimated based on a site specific study by a hydrometeorological analysis, application of hurricane model or a statistical method. Case studies are presented for four projects, each of different nature and scope located in the area of different physiographic and climatic conditions. The amount and quality of data available for each project are also different. It is difficult to determine which of the procedures yields most reliable results because geophysical and meteorological conditions vary from one basin to another and data situations change from basin to basin. Any PMP estimate must be considered as an approximation which can vary over a range of values depending on input data used, and assumptions made in deriving the estimate. Some conservatism should be considered in the analysis depending on potential consequences of underestimating the PMP and therefore the PMF. (Moore-IVI)
W85-03012

**SPECTRAL THEORY OF RAINFALL INTENSITY AT THE MESO-BETA SCALE,**
Oregon State Univ., Corvallis. Dept. of Mathematics.
E. Waymire, V. K. Gupta, and I. Rodriguez-Iturbe.
Water Resources Research, Vol. 20, No. 10, p 1453-1465, October, 1984. 2 Fig, 2 Tab, 26 Ref.

Descriptors: *Rainfall intensity, *Storms, *Stochastic hydrology, Rainfall, Cyclones.

The available empirical descriptions of extratropical cyclonic storms are employed to formulate a physically realistic stochastic representation of the ground level rainfall intensity field in space and time. The stochastic representation is based on three-component stochastic point processes which possess the general features of the embedding of rain cells within small mesoscale areas within large mesoscale areas within synoptic storms. Certain scale idealizations, and assumptions on functional forms which qualitatively reflect the physical features, lead to a closed form expression for the covariance functions, that is, the real space-time spectrum, of the rainfall intensity field. Of particular interest and importance is an explanation of the empirical observation that the Taylorian propagation of the fine scale structure, via a transformation of time to space through the storm velocity, holds only for a small time lag and not throughout. The results indicate the extent of this lag in terms of the characteristic scales associated with cell durations and cellular birthrates and velocities. The present findings show the validity of Taylor's hypothesis holds only under restricted physical conditions, as when cells' speeds relative to the storm are zero, and holds only for time spans smaller than mean cell life rather than for all times. These important physical limitations on the validity of Taylor's hypothesis in rainfall have not been taken into account in other stochastic rainfall models. (Baker-IVI)
W85-03169

**ELECTRICAL RESISTIVITY STUDIES TO DELIMIT ZONES OF ACCEPTABLE GROUND WATER QUALITY,**
Geo-Recon International Ltd., Seattle, WA.
C. A. Ringstad, and D. C. Bugenig.
Ground Water Monitoring Review, Vol. 4, No. 4, p 66-69, Fall, 1984. 5 Fig, 2 Tab.

Descriptors: *Groundwater, *Water quality, *Resistivity, Permeability, Water analysis, Water resources development.

Four vertical electrical soundings were conducted in a layered andesitic rock aquifer known in places to yield ground water with total dissolved solids in excess of 2,000 milligrams per liter. The objective of the soundings was to determine if adequate supplies of good quality ground water could be derived from the volcanic rocks and to select a site for confirmatory drilling and testing. The resistivity of a geologic unit is a function that includes the quantity of total dissolved solids in the interstitial water and the distribution of the water within the unit. Thus, the resistivity of most granular soils and rocks is controlled more by porosity, water content and water quality than by the conductivity of the matrix materials. The electrical data delimited a drill site where it was believed that ground water of acceptable chemical quality could be expected. Two exploration wells confirmed the expectations. (Baker-IVI)
W85-03176

## 2C. Snow, Ice, and Frost

**MODEL FOR PREDICTING ICE ACCRETION AND ABLATION IN WATER BODIES,**
Atmospheric Dynamics Corp., Victoria (British Columbia).
M. Danard, M. Gray, and G. Lyv.
Monthly Weather Review, Vol. 112, No. 6, p 1160-1169, 4 Fig, 7 Tab, 44 Ref.

Descriptors: *Ice formation, *Ablation, *Model studies, Radiation, Cloud cover, Snow cover, Ice, Ice-water interfaces, Melting.

A model is presented for computing ice growth and ablation. Downward long- and shortwave radiation is computed for variable cloud amount and base. Surface albedo depends on snow cover and age of the snow or ice. Thermal inertia of the snow and ice is included. Sensible and latent heat fluxes are calculated using generalized similarity theory. The model is tested in Mackenzie Bay for the 1978-79 season and produces results in good agreement with observations. Perhaps the most surprising finding is the importance of longwave radiation. A variation in surface emissivity between accepted values can produce significant changes in computed melting dates. An increase in cloudiness during ablation actually accelerated melting, due to increased downward longwave radiation. Heat input from the water at the water-air interface is also important. This may be estimated from measurements of water currents and temperatures. (Baker-IVI)
W85-02797

**HYDROTHERMAL PROCESSES BENEATH ARCTIC RIVER CHANELS,**
National Hydrology Research Inst., Ottawa (Ontario).
A. Wankiewicz.
Water Resources Research, Vol. 20, No. 10, p 1417-1426, October, 1984. 10 Fig, 23 Ref.

Descriptors: *Hydrothermal studies, *Frozen ground, *Rengleng River, *Caribou Creek, *Northwest Territories, Groundwater flow, Dispersion, Heat flow, Physical properties.

Perennially unfrozen ground (river talik) exists beneath Rengleng River and Caribou Creek near Inuvik, Northwest Territories. Subchannel ground temperature observations to 13 meters depth were obtained in April, August, and November of 1977-1978. These observations indicate several facts concerning heat transfer processes of importance to thermal modeling of Arctic stream crossings. The heat flow in sediments beneath Caribou Creek channel is due to simple conduction. The effective thermal conductivity of sediments beneath Rengleng River channel is more than an order of magnitude greater than simple conduction as a result of heat dispersion by flowing groundwater in the talik. Seasonal change in groundwater discharge beneath Rengleng River channel is apparently re-

sponsible for the four-fold variation in effective thermal conductivity of the sediments. In late winter, after the streams have frozen solid, frost develops in the streambeds; the frost thickness is as much as 2 meters. Warming of the streambed by the spring runoff is delayed by as much as 30 days, due to the presence of bed-fast ice and streambed frost. Predicting disturbance to the hydrothermal regime by engineering structures requires numerical simulation using representative thermal parameters. Where sediments at stream crossings are unfrozen and highly permeable, a groundwater flow contribution to both convective heat transport and effective thermal conductivity should be taken into account. (Baker-IVI)
W85-03165

**GROUNDWATER HYDRAULICS OF SEASONAL FROST MOUNDS, NORTH FORK PASS, YUKON TERRITORY,**
Ottawa Univ. (Ontario). Dept. of Geography.
W. H. Pollard, and H. M. French.
Canadian Journal of Earth Sciences, Vol. 21, No. 10, p 1073-1081, October, 1984. 6 Fig, 4 Tab, 43 Ref. Natural Sciences and Engineering Research Council of Canada grant A8367.

Descriptors: *North Fork Pass, *Yukon Territory, *Groundwater hydrology, *Frost mounds, Frost, Hydraulic potential, Transmissivity, Springs.

Seasonal frost mounds occur in the North Fork Pass area in response to increased hydraulic potentials in perennial, spring-fed groundwater systems. Geochemical and isotope analyses indicate that local precipitation is the source of water for flow systems discharging from the springs. While there is an importance attached to the role of groundwater under pressures as the dynamic component of seasonal frost mound growth in earlier studies of this type, the present study confirms this assumption by documenting the existence and magnitude of these pressures. These observations also emphasize the genetic differences between seasonal frost mounds and other morphologically similar features such as palsas. It is suggested that the processes and mechanisms of palsa formation are considerably different from those associated with seasonal frost mounds. In the former, ice segregation and the formation of ice lenses in the mineral soil core are the primary growth mechanisms, and capillary flow and moisture migration during ice segregation are the main hydrologic processes. In contrast with both palsas and pingos, and also probably to the wide range of smaller tundra mounds, seasonal frost mounds are relatively short-lived phenomena that form in early to mid-winter in response to a decrease in hydraulic transmissivity and an increase in hydraulic potential in the active layer. (Baker-IVI)
W85-03198

## 2D. Evaporation and Transpiration

**XYLEM WATER FLOW IN A CRACK WILLOW TREE (SALIX FRAGILIS L.) IN RELATION TO DIURNAL CHANGES OF ENVIRONMENT,**
Vysoka Skola Zemedelska, Brno (Czechoslovakia). Inst. of Forest Ecology.
For primary bibliographic entry see Field 2I.
W85-02900

**DESIGN AND IMPLEMENTATION OF EVAPOTRANSPIRATION MEASURING EQUIPMENT FOR OWENS VALLEY, CALIFORNIA,**
M. R. Simpson, and L. F. W. Duell, Jr.
Ground Water Monitoring Review, Vol. 4, No. 4, p 155-163, Fall, 1984. 6 Fig, 17 Ref.

Descriptors: *Evapotranspiration, *Rangeland, *Measuring instruments, *Owens Valley, *California, Model studies, Eddy correlation.

Semipermanent installations are used to measure continuous rangeland evapotranspiration in the valley's phreatophyte community as part of a plant survivability and ground water study in Owens Valley, California. The semipermanent micrometeorological station collects continuous data for solution of the Bowen ratio energy budget equation and the Penman combination equation. Three sites were chosen for this type of installation to provide a representative sampling of Owens Valley. The proposed mobile aerodynamic installation should be capable of calculating evapotranspiration by the eddy correlation method. This instrumentation will be used throughout the valley for short periods of time (up to five days). Many problems have been identified and resolved through improved calibration techniques, systematic error-removal techniques, reduced cycle times, modified equiment design and proper observer training. The collected evapotranspiration data will be instrumental in developing a one-dimensional evapotranspiration flux algorithm for a model of valleywide ground water flow. (Baker-IVI)
W85-03188

## 2E. Streamflow and Runoff

**EFFECTS OF VISITATION FREQUENCY AND INSTRUMENT RELIABILITY ON THE ACCURACY OF ESTIMATION OF RIVER DISCHARGES,**
Iowa Inst. of Hydraulic Research, Iowa City.
P. K. Kitanidis, O. G. Lara, and R. W. Lane.
Hydrological Sciences Journal, Vol. 29, No. 3, p 255-269, 1984. 2 Fig, 4 Tab, 7 Ref.

Descriptors: *Measuring instruments, *Streamflow, *Model studies, Probabilistic models, Flow discharge, Simulation.

The extent to which improved instrumentation and longer visitation periods result in improved accuracy of estimation of streamflow quantities is examined. A relatively simple probabilistic model of the process of gauging-station failures is developed, calibrated, and validated. This model can be used to derive the distributions of the number of failures and the length of missing records and, through simulation, to calculate the accuracy of daily or monthly streamflow values. The paper focuses on the description of the probabilistic model, on the derivation of the distribution of the number of failures and the length of missing record, and on the estimation of parameters from data. For illustration, the performance characteristics of 168 gauging stations are analyzed. (Baker-IVI)
W85-02825

**ISOLATED EVENT MODEL BASED UPON DIRECT RUNOFF CALCULATIONS USING AN IMPLICIT SOURCE AREA CONCEPT,**
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
D. A. Hughes.
Hydrobiological Sciences Journal, Vol. 29, No. 3, p 311-325, 1984. 4 Fig, 5 Tab, 17 Ref.

Descriptors: *Floods, *South Africa, *Model studies, *Rainfall, *Runoff, Storm runoff, Seasonal variation, Hydrographs, Semiarid climates, Flood peak.

An isolated event flood model is described that is based upon the concept of expanding source areas using an S-curve function to relate the proportion of rainfall that becomes stormflow to the moisture status of the catchment. The results of calibrating the model using some storms drawn from semiarid and sub-humid South African catchments are encouraging and illustrate that the model can be used for complex storms with more than one flow peak. The antecedent rainfall function which determines the initial moisture status of the catchment is one aspect of the model where there is need for improvement. The relatively simple function used does not appear to be adequate to account for the variable moisture conditions that occur prior to storms. This conclusion is particularly relevant to the semiarid region of the Eastern Cape where there are very distinct seasonal differences in rainfall characteristics. The variation in parameter values between storms on the same catchment and between different catchments are broadly explicable in terms of catchment and storm characteristics. The question of parameter interpretation requires further research, involving the calibration and verification of the model on far more catchments. Only then will it be possible to consider whether the model will be truly flexible and applicable, to design situations when calibration using observed data is not possible. (Baker-IVI)
W85-02829

**GEOMORPHIC AND VEGETATIVE CHARACTERISTICS ALONG THREE NORTHERN VIRGINIA STREAMS,**
Geological Survey, Reston, VA.
W. R. Osterkamp, and C. R. Hupp.
Geological Society of American Bulletin, Vol. 95, No. 9, p 1093-1101, September, 1984. 7 Fig, 4 Tab, 43 Ref.

Descriptors: *Geomorphology, *Sediments, *Vegetation, *Streams, *Virginia, Topography, Species distribution, Bars, Floodplains, Shelf, Terraces, Flooding.

Bottomland features of three perennial northern Virginia streams include the depositional bar, the active-channel shelf, the flood plain, and sometimes one or more terraces. Excepting terraces, each surface is inundated through a narrow range of flow frequencies. Relative to discharge, shelf and food-plain areas, respectively, appear to vary directly and inversely with stream power. The consistency of these data, their agreement with results from other studies, and size data of surficial sediment indicate that bottomland alluvial estuaries are formed and maintained by hydraulically controlled sorting processes. Binary discriminant analysis suggests that bottomland woody-plant assemblages may be nearly specific for a given geomorphic surface, regardless of stream size or physiographic province. Correlation also is indicated between species distribution and sediment type, but this relation may result from distributions being indicative of the surfaces upon which they occur. Depth to saturation appears to be insignificant. It seems possible that species distributions on bottomland geomorphic surfaces are related to intensities, damage, and frequencies of flow events. Woody plants provide a convenient and dependable means of identifying and delineating lowland surfaces, regardless of the causes of the distributions. (Baker-IVI)
W85-02834

**HYDRAULIC-RESISTANCE TERMS MODIFIED FOR THE DRESSLER CURVED-FLOW EQUATIONS,**
George Washington Univ., Washington, DC. International Water Resources Inst.
R. F. Dressler, and V. Yevjevich.
Journal of Hydraulic Research, Vol. 22, No. 3, p 145-156, 1984. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Dressler equations, *Hydraulic resistance, *Saint-Venant equations, *Channel flow, Turbulent flow, Transition flow, Rough flow, Hydrodynamics, Hydraulics, Flow characteristics.

The well-known empirical hydraulic-resistance terms, in common use with the Saint-Venant equations, are here modified to the specific functional form necessary for their use with the Dressler equations for curved open-channel two-dimensional flow in rectangular channels. From the general resistance term three cases are considered for three regimes of turbulent flow: the Blasius 'smooth' flow, the Chezy 'transitional' flow; and the Manning 'rough' flow. These new functions are composed with the analogous terms in common use with the Saint-Venant equations. The modifications needed for the Dressler equations for the Chezy and Manning regimes are incorporated in two extra factors, am and av. The am factor is a given function of channel bottom curvature K and of flow perpendicular thickness N, expressing the mass change affected by a boundary drag when flow is over a convex or concave bottom. The av factor is a given function of K, N, and channel width w, expressing the modification required in bottom velocity C to adjust for the variable velocity profile in curved flow. For the Blasius regime, an additional function aq is required to adjust the

velocity near the bed to the average velocity over the profile. Each of the three functions ai reduces the unity when K = 0. An example is presented showing their numerical values for KN = -0.4 (convex) and + 0.4 (concave). Their behavior shows that the hydraulic resistance effect is decreased when the channel bottom is convex, but increased when concave, and these changes are greater in narrow channels than in wide channels. (Author's abstract)
W85-02929

**DYNAMICS OF A RIVER-BAY-DELTA SYSTEM,**
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
F. C. Wang.
Journal of Geophysical Research, Vol. 89, No. C5, p 8054-8060, September, 1984. 8 Fig, 1 Tab, 25 Ref. U.S. Army Engineer Waterways Experiment Station contract DACW-39-82-C-0004.

Descriptors: *Plane jets, *Bays, *River mouth, *Deltas, *Atchafalya River Delta, *Louisiana, Hydrodyamics, Flow continuity, Momentum balance, Mathematical equations, Mass transport.

An analysis has been made to aid our understanding of various phenomena associated with turbulent plane jets that issue from river outlets and discharge into quiescent bays. An integrated form of the hydrodynamic equations of flow continuity and momentum balance, coupled with advective-diffusion mass transport equations, has been formulated into a two-dimensional spatial domain. Closed-form analytical solutions are obtained with the aid of similarity functions for the velocity and sediment concentration profiles. A numerical procedure for estimating the areal and volume deposition of the delta sediments is presented. The Atchafalya River Delta, a newly developing delta in the south central Louisiana Coast, is used to illustrate analytical techniques. The results of analytical predictions are compared with the results predicted by other statistical and generic approaches; an agreement is found. A sensitivity analysis is performed to assess the relative importance of various parameters in the river-bay-delta system. (Author's abstract)
W85-02961

**JUNCTION ANGLES IN DRAINAGE NETWORKS,**
Jet Propulsion Lab., Pasadena, CA.
D. C. Pieri.
Journal of Geophysical Research, Vol. 89, No. B8, p 6878-6884, August, 1984. 6 Fig, 2 Tab, 24 Ref. NASA contract NAS 7-100 and grant NGL 33-010-082.

Descriptors: *Tributaries, *Junction angles, *Drainage patterns, Topology, Topography, Slope, Remote sensing, Drainage basins, Streams.

The systemics of tributary junction angles are an important link between the topology of a drainage network and its topography because the angle of junction depends on the relative slopes of the intersecting tributaries. A model is presented here for stream junction angle as a function of position (link magnitude) within the network which quantitatively predicts the observed down-network increase of junction angle for tributaries joining progresively larger recipient links. Good agreement between model and data exists for mature drainage networks mapped at varying scales. Additionally, the dependency of junction angle on relative tributary slopes suggests that as individual links within the network modify their slopes to evolve toward graded longitudinal profiles, there exists a central tendency within the network, modulated by structural and lithologic controls, for evolution to an equilibrium of 'graded' planimetric pattern. Extraction of process-related (as opposed to purely topological) information from network planimetric pattern is important in terrestrial and planetary remote sensing applications. (Author's abstract)
W85-02963

**FLOOD WARNINGS AND FLOOD RESPONSES FOR THE RED RIVER OF THE NORTH,**
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W85-02988

**COMPUTATION OF DYNAMIC WAVES IN CHANNEL NETWORKS,**
For primary bibliographic entry see Field 8B.
W85-03007

**REGULAR MEANDER PATH MODEL,**
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-03009

**BOUNDARY SHEAR IN SYMMETRICAL COMPOUND CHANNELS,**
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-03010

**SECONDARY CURRENT AND RIVER-MEANDER FORMATION,**
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
P. K. Kitanidis, and J. F. Kennedy.
Journal of Fluid Mechanics, Vol. 144, p 217-229, July, 1984. 2 Fig, 29 Ref.

Descriptors: *Fluid mechanics, *Meanders, Perturbation, Water currents, Stability analysis, Mathematical studies.

A small perturbation stability analysis is presented for investigating the role of the secondary current which accompanies channel curvature in the initiation and early development of meanders of alluvial and ice- or rock-incised streams. A small sinusoidal perturbation is introduced in the channel alignment of an initially straight prismatic channel. The equation of the conservation of moment of momentum is applied to calculate the velocity of the secondary flow for uniform quasi-steady flow conditions. The formulation is then closed by introducing the assumption that the differential, between the outer and inner banks, rate of boundary erosion, dissolution or melting, or sediment discharge is proportional to the strength of the secondary flow. This formulation leads to a linear differential equation which is solved for its orthogonal components which give the rates of meander growth and downstream migration. The amplitude of the meanders tends to increase and the meanders migrate downstream. The dominant wavelength and the corresponding phase shift between channel meandering and the velocity of the spiral motion are calculated as those corresponding to the fastest growth rate. The results are in good agreement with data reported by other investigators. (Baker-IVI)
W85-03035

**WIND-INDUCED ENTRAINMENT IN A STABLY STRATIFIED FLUID,**
Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
C. Kranenburg.
Journal of Fluid Mechanics, Vol. 145, p 253-273, August, 1984. 9 Fig, 6 Tab, 23 Ref.

Descriptors: *Entrainment, *Stratification, *Streamflow, *Wind, Flumes, Turbulent flow, Coriolis Force, Richardson Numbers, Density, Velocity, Mixing.

Experiments were carried out on mixed-layer deepening in a straight wind flume initially containing a two-layer fluid. To simulate an effectively unlimited water body, or a situation where the presence of endwalls is not yet noticeable, the water from the upper layer was withdrawn at the downstream end, and supplied against the upstream end in part of the experiments. As a consequence curvature effects as encountered in annular tanks were absent. While the additional mixing caused by recirculation was not negligible, the extrapolation to the situation where recirculation is absent was straightforward. Upper-layer depths, and mean-density and mean-velocity profiles were measured for overall Richardson numbers ranging from 22 to 1090 based on the surface friction velocity. Gradient Richardson numbers in the transition layer and in the mixed layer were estimated. The observed mean density and velocity profiles as well as visual observation showed the development of a mixed layer with little density differences and a transition layer with relatively large density and velocity gradients. In all experiments the transition layer occupied a considerable part of the total upper layer. The surface shear layer was less developed than in the case of homogeneous flow. As judged from the gradient Richardson number, the turbulence in the transition layer is on a near-critical condition when recirculation is absent. Shadowgraph images showed large-scale structure in the transition layer, whereas the mixed layer appeared more uniform. The entrainment process seems to be dominated by mixing in boils, highly turbulent patches temporarily protruding into the undisturbed layer. Intermittent small-scale wave breaking, producing filaments and small clouds was observed under specific conditions. (Baker-IVI)
W85-03037

**TWO-STAGE URBAN RUNOFF FORECAST MODEL,**
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
G. G. Patry, and M. A. Marino.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 479-496, October, 1984. 4 Fig, 6 Tab, 28 Ref, 1 Append. CSRS project CA-D*-LAW-4254-H.

Descriptors: *Urban runoff, *Storm runoff, *Runoff forecasting, *Computer models, Combined sewer overflows, Storm wastewater, Water pollution control, Automation.

Storm-related pollution in general, and combined sewer overflows in particular, have been found to contribute significant amounts of pollutants to receiving water bodies. Control of pollution from these nonpoint sources of pollution is very costly. Accordingly, integrated real-time control of combined sewer overflow is being considered as a possible alternative to the more traditional forms of pollution control. The basic features of suggested control combined sewer overflow control strategies are reviewed, including simple local control, reactive control, and anticipatory control. Because water quantity forecasts are essential to any integrated real-time control strategy, the application of a simple microcomputer-based two-stage urban runoff forecast model is examined. Runoff forecasts from this deterministic-stochastic model are provided for lead times ranging from 1-12 time steps (5-60 min). The two-stage approach is found to be particularly useful for lead times of up to 30 min. (Author's abstract)
W85-03065

**CHARACTERIZATION OF DRAINAGE ON RECLAIMED LAND MINED UNDER PUBLIC LAW 95-087,**
Missouri Univ.-Rolla. Dept. of Geological Engineering.
C. D. Elifrits.
Transactions of the Missouri Academy of Science, Vol. 17, p 155-162, 1983. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Drainage patterns, *Land reclamation, Infrared imagery, Aerial photography, Strip mines, Coal mines, Legislation, Erosion, Sedimentation.

Under Public Law 95-087, lands disturbed by surface coal mining must be reclaimed so as to have a surface which must have morphology similar to the original landscape and be free of actively eroding gullies. Drainage developed on terrain created to conform with current reclamation regulations

was compared to that of adjacent undisturbed terrain subjected to similar land use. All drainage features were mapped from color infrared aerial photography. On the reclaimed land, drainage densities were on the order of less than one half (50%) of those found on the adjacent undisturbed terrain. With time this smooth surface will lead to erosion and sedimentation problems once this land is no longer maintained as required by regulation during the bonding period. The current regulatory requirements, while assuring minimum environmental impact of mining, produce a site which does not show promise of being stable after the repair work is ended. (Moore-IVI)
W85-03069

**GREAT SALT LAKE GETS GREATER EVERY DAY,**
L. Ware.
Audubon, Vol. 86, No. 5, p 118-131, September, 1984. 6 Fig.

Descriptors: *Great Salt Lake, *Utah, *Water level, Lakes, Flooding, Lake morphology, Evaporation, Lake basins, Lake shores, Ecological effects, Land development.

Melting snows in surrounding mountains have brought the water level in the Great Salt Lake (Utah) to more than 9 ft above the 4200 ft level, which has been the lake's approximate elevation for 135 yr. Because of the low relief in the lake basin, this comparatively small increase in depth has caused an additional 267 square miles of land to become inundated. Highways, businesses, and wildlife management facilities have been damaged or destroyed by flooding. In addition to the water from melting snow, record rainfalls and reduced evaporation due to cooler weather have contributed to a steadily increasing water level over the past 2 yr. Almost 90% of federally managed marshlands have been flooded, and about 50-60% of the state-managed marshes are inundated. Birds, including coots, ducks, Canada geese, and phalaropes, have been forced to find other areas for stopovers; formerly tens of thousands of birds used Great Salt Lake facilities. Further increases in lake levels will destroy many public facilities of considerable economic value, as well as force retreating wildlife into close contact with human settlements. To prevent future damage it may be necessary to restrict development of lakeshore lands. Another approach would be to pump water out of the lake and pipe it to the desert on the western side of the lake. Dams on feeder streams have also be considered as possible solutions; both schemes would be very expensive to implement. (Rochester-IVI)
W85-03078

**PLOTTING POSITIONS FOR PEARSON TYPE-III DISTRIBUTION,**
Yangtze Valley Planning Office, Wuhan (China).
X. Ji, J. Ding, H. W. Shen, and J. D. Salas.
Journal of Hydrology, Vol. 74, No. 1/2, p 1-29, October, 1984. 1 Fig, 10 Tab, 24 Ref, 1 Append.

Descriptors: *Hydrology, *Pearson type III distribution, Monte Carlo method, Mathematical studies, Statistical analysis, Skewness.

The Monte Carlo method is suitable for developing plotting postion formulas under Pearson type-III distributions. From the generation of a total of 340,000 traces with sample sizes ranging from 30 to 100, it was found that the following properties were preserved: basic statistical characteristics; the expectation of frequencies of order statistics; and frequencies of exceedance of order statistics. The calculated b-values from the generated data in the plotting position formulas agree with the b-values obtained from direct numerical integration. A plotting position formula is developed for P-III distribution based on the generated data for Cs coefficients of skewness of parent distribution in the range of between 0 and 2. The formula can be applied to both symmetrical and unsymmetrical parent distributions and will also provide unbiased and efficient estimations of quantiles. This formula compares favorably with all currently available formulas. In order to use this developed plotting position formula, a coefficient b must be determined. These b-values are mainly dependent on the values of Cs and the order number of the arranged sample. (Moore-IVI)
W85-03079

**EVALUATION OF TRACER DILUTION TECHNIQUES FOR GAUGING OF RIVERS IN FLOOD,**
Australian Atomic Energy Commission Research Establishment, Sutherland.
P. L. Airey, G. E. Calf, A. Davison, J. F. Easey, and A. W. Morley.
Journal of Hydrology, Vol. 74, No. 1/2, p 105-118, October, 1984. 5 Fig, 16 Ref.

Descriptors: *Tracers, *Dilution, *River gauging, *Floods, Floodplains, Mixing, Turbulence, Velocity, Wave front.

The use of the tracer dilution technique to gauge flow over broad shallow floodplains is examined. Because of the long mixing lengths, it sometimes takes several days for the passage of the laterally dispersed pulse. Tracer methods can be used if the flow rates vary linearly during the passage of the pulse. The measured flow rate is related to the time at which the first moment of the concentration profile is zero. An experimental verification is presented. By analyzing the tracer pulse shapes before the establishment of complete mixing, it was demonstrated that the effective dispersion coefficients were independent of the scale of turbulence over the range 10 m to ca. 1 km. This is consistent with the establishment of isotropic turbulence on the floodplain in contrast to oceanic surfaces. The velocity of the tracer is a factor of 2 less than that of an advancing wave front, which is in acceptable agreement with prediction. It is concluded that the transport of a non-interacting contaminant across the flood-plain can be predicted from the wave front velocity and the dispersion coefficients measured close to the release point. (Author's abstract)
W85-03085

**RESPONSE TO PRECIPITATION OF HEADWATER STREAMS IN HUMID AREAS,**
Hull Univ. (England). Dept. of Geography.
R. C. Ward.
Journal of Hydrology, Vol. 74, No. 1/2, p 171-189, October, 1984. 8 Fig, 54 Ref.

Descriptors: *Humid areas, *Rainfall-runoff relationships, *Streamflow, Storm seepage, Infiltration, Quickflow, Overland flow, Saturated flow, Unsaturated flow, Matrix flow, Pipeflow.

In most humid areas the majority of precipitation infiltrates the soil surface and as a result quickflow may result from water entering the stream channels via subsurface flow paths and by overland flow from surface-saturated source areas of variable size. The distribution of variable source areas appears to be related strongly to the occurrence of subsurface flow convergence. The relative importance of saturated and unsaturated matrix flow and turbulent pipeflow are matters of continuing debate and investigation, although accumulated evidence indicates that all three subsurface flow paths may play an important role in the response of headwater streams to precipitation. Until it is possible to identify accurately and quantify the individual flow paths of water in the runoff process it will not be possible to predict satisfactorily the effects of pollution, agricultural practices, forest management techniques or land drainage improvements upon the quantity and quality of water in stream channels or to finalize models of erosion and slope development. (Moore-IVI)
W85-03089

**INFILTRATION MEASUREMENTS IN A SMALL LOWLAND CATCHMENT,**
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
D. N. Wilcock, and C. I. Essery.
Journal of Hydrology, Vol. 74, No. 1/2, p 191-204, October, 1984. 6 Fig, 4 Tab, 21 Ref.

Descriptors: *Infiltration, *Organic matter, *Northern Ireland, Soil water, Soil texture, Catchment area, Hydrographs, Slope, Infiltration rate, Infiltration capacity.

Infiltration rates into the glacial boulder clay of Northern Ireland, U.K., were determined from cylinder infiltrometers and from hydrograph analyses in a small instrumented catchment. Infiltrometer readings were made monthly at eleven sites in the catchment for a year. Organic matter appears to be the most important site factor controlling infiltration capacity with slope next in importance. Other factors investigated as site controls on infiltration capacity were soil texture and antecedent soil moisture. Infiltration capacity varied little from site to site at any time of year and was always very low, even in summer. Mean infiltration capacity determined from these site readings for the whole catchment varies from 0.6 mm/hr in January to about 9 mm/hr in June. Site variation was greatest in summer. The maximum site reading obtained was 19.7 mm/hr in June. 'Average infiltration' rates determined from conventional hydrograph analyses are very similar to the infiltration capacities determined for the whole catchment from the infiltrometer readings, especially in winter. The close similarity in winter between infiltration rates determined from the two independent methods suggests in fact that they each measure the same process (i.e. surface infiltration capacity) or that the process of infiltration is relatively uniform through the soil profile and proceeds at a rate close to the infiltration capacity. (Author's abstract)
W85-03090

**DESIGN FOR A STABLE CHANNEL IN COARSE ALLUVIUM FOR RIPARIAN ZONE RESTORATION,**
Bureau of Land Management, Denver, CO.
W. L. Jackson, and B. P. Van Haveren.
Water Resources Bulletin, Vol. 20, No. 5, p 695-703, October, 1984. 7 Fig, 2 Tab, 22 Ref.

Descriptors: *Alluvial channels, *Streams, *Rehabilitation, Stability, Riparian waters.

Geomorphic, hydraulic and hydrologic principles are applied in the design of a stable stream channel for a badly disturbed portion of Badger Creek, Colorado, and its associated riparian and meadow complexes. The Badger Creek watershed is 569 sq km with steep slopes and generally shallow soils. High rates of runoff and erosion occur during summer convectional storms. The lower Badger Creek project area was a broad, gently sloping alluvial meadow which had been eroded as a result of a stream channel system which became more active than its historic norm. This was probably caused by changes in watershed conditions due to overgrazing, timber harvest, road building and mineral exploration which resulted in increased sediment delivery, and possibly increased freqency of large peak flows. Channel geometry measurements describe the stream channel and the normal bankfull stage in relatively stable reaches. Critical shear stress equations were used to design a stable channel in noncohesive materials with dimensions which approximate those of less disturbed reaches. Gabion control, spaced at approximately 300 m intervals, are recommended to help reduce the chance of lateral migration of the newly constructed channel. Controls are designed to allow for some vertical adjustment of the channel bed following increased bank stability due to revegetation. The flood plain is designed to dissipate flood flow energy and discourage multiple flood channels. The channel has approximately a 90% chance of remaining stable the first two years following construction, the time estimated for increased stability to occur due to revegetation. (Baker-IVI)
W85-03135

**FORESTS AND OTHER FACTORS ASSOCIATED WITH STREAMFLOWS IN EAST TEXAS,**
Stephen F. Austin State Univ., Nacogdoches, TX. School of Forestry.
M. Chang, and S. P. Watters.
Water Resources Bulletin, Vol. 20, No. 5, p 713-719, October, 1984. 2 Fig, 4 Tab, 25 Ref.

Descriptors: *Streamflow, *Forest watersheds, *Texas, Forests, Forest hydrology, Hydrologic cycle.

Effects of proportion of watersheds in forest and watershed physiographic factors on mean annual streamflow, median flow, and 12 flood flow characteristics were regionally analyzed for 19 unregulated streams in East Texas. Annual streamflow increases with decreasing percent forest area in these watersheds. Differences in annual streamflow between full forest cover and bare watersheds could be as much as 200 mm. Forests are also associated with flood flows in the study area, but the effect diminishes with storm duration and storm size. If a watershed shape parameter is equal to or greater than 0.565 and other things being equal, the minimum watershed area required to generate 0.142 cms, a criterion used by the US Corps of Engineers in regulating dredge or fill activity for water pollution abatement in the East Texas streams, is 70 sq km. (Baker-IVI)
W85-03137

**NITRATE TRANSFORMATIONS IN SOUTHERN ONTARIO STREAM SEDIMENTS,**
York Univ., Downsview (Ontario). Dept. of Geography.
M. D. Wyer, and A. R. Hill.
Water Resources Bulletin, Vol. 20, No. 5, p 729-737, October, 1984. 3 Fig, 5 Tab, 29 Ref.

Descriptors: *Nitrate, *Streams, *Sediments, Denitrification, Water quality, Eutrophication, Bacteria, Ammonium.

Sediments from diverse stream environments in Southern Ontario are shown to exhibit considerable nitrate removal potentials due to bacterial denitrification and nitrate reduction to ammonium. The data also suggest that ammonification and nitrification can occur concurrently with nitrate reduction in many stream sediments. Rates of NO3-N loss from aerated 5 mg/l nitrate-N solutions overlying 0.5 cm depth sediments ranged from 11171 mg/sq m/day for a 24 hr incubation period. Microbial nitrate removal also occurred in sediments from 5-10 cm depths, although losses were significantly lower than in the surface sediment layer. Rates of nitrate removal showed considerable variability within individual stream reaches; however, differences between most of the regions analyzed were relatively small. Nitrate loss from 0.5 cm depth sediments was positively correlated with sediment ammonium and to a lesser extent with organic carbon, total nitrogen and texture. These results suggest that a wide variety of stream sediments have a potential for nitrate removal from oxygenated streams draining forest and agricultural landscapes. (Baker-IVI)
W85-03139

**FLOOD FREQUENCY CHARACTERISTICS OF SOME ARIZONA WATERSHEDS,**
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton, and K. G. Renard.
Water Resources Bulletin, Vol. 20, No. 5, p 761-769, October, 1984. 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Flood frequency, *Watersheds, *Arizona, *Distribution, *Australia, Floods, Statistical analysis.

The flood frequency characteristics of 18 watersheds in southeastern Arizona were studied using the log-Boughton and the log-Pearson Type 3 distribution. Results showed an average relationship between frequency factor and the lnln(T/(T-1)) function of recurrence interval, which closely resembles the relationship for Australian data on which the log-Boughton distribution was originally based. Fitting techniques allow this distribution to overcome some peculiar fittings produced by one or more very low flood values; there is a systematic increase in the shape parameter with increase in watershed area in the study region. (Baker-IVI)
W85-03142

**HEURISTIC METHOD FOR MEASUREMENT AND CHARACTERIZATION OF RIVER MEANDER WAVELENGTH,**
Sandia National Labs., Albuquerque, NM.
S. Sinnock, and A. R. Rao.
Water Resources Research, Vol. 20, No. 10, p 1443-1452, October, 1984. 16 Fig, 1 Tab, 40 Ref. US Dept. of Energy DE-AC04-DP00789.

Descriptors: *Meanders, *Rivers, Streamflow, Model studies, White River, Indiana, Fourier analysis.

Meander wavelength was analyzed in the Fourier frequency domain by power spectral analysis in terms of hierarchical center lines as a reference geometry, eliminating some of the subjective bias associated with wavelength measurements. Equally spaced sampling points were located along the talweg of meandering streams. Sample values were measured as the perpendicular distance to a reference line connecting meander belt midpoints. This line, itself meandering, constitutes a river's second order meander frequency, which is analyzed with respect to a still higher order reference line. Sampling along the talweg attenuates the spectral estimates of natural frequencies of meanders. Corrections are obtained by multiplying frequency peaks by the sinuosity of the study reach. Power spectra obtained from hierarchical reference lines of first- and second-order meanders of the White River in southern Indiana indicate discrete frequencies in each order. First- and second-order harmonics are observed at high and low frequencis. Complex meandering along the Dolores River in western Colorado is characterized by very low-frequency energy in third-order meanders and successively higher frequency energy in second- and first-order meanders. A comparison of power spectra for hierarchical and arbitrary reference lines shows that arbitrary references condense spectral estimates of meander energy within artificially averaged frequency bands. Another comparison, using the theory of minimum variance for meander formation, confirms that hierarchical reference lines improve meander characterization. (Baker-IVI)
W85-03168

**PROCESS AND DISCHARGE ESTIMATION IN EPHEMERAL CHANNELS, CANADIAN ROCKY MOUNTAINS,**
British Columbia Univ., Vancouver. Dept. of Geography.
J. R. Desloges, and J. S. Gardner.
Canadian Journal of Earth Sciences, Vol. 21, No. 9, p 1050-1066, September, 1984. 5 Fig, 4 Tab, 35 Ref.

Descriptors: *Channels, *Canadian Rocky Mountains, *Discharge hydrographs, *Ephemeral streams, Tributaries, Streamflow, Mountains, Floods, Debris flows, Avalanches, Flow discharge.

Process determinations and discharge estimates are made for 10 steep alpine channels in the Front and Main ranges of the southern Canadian Rocky Mountains. The catchments, which range in size from 0.17 to 1.13 sq km are sufficiently small that their runoff patterns are dominantly ephemeral and are characterized by processes that include water floods, debris flows, and snow avalanches. Occurrence of dominance of a particular process is related to sources of water and the availability of weathered debris. Because of the lack of measured data and low frequency of events, information on peak discharges in the ephemeral channels must be derived by indirect means. Discharge estimates based on gross channel morphology probably result in overestimation if multiple processes occur in the channel. Thus reliable estimates of peak discharge require prior identification of channels or reaches of channels that are fluvially dominated. The slope-area method of discharge estimation may yield more representative results in the absence of significant channel widening. The multiple origin and reworking of sediments confuse estimates based on competence. (Baker-IVI)
W85-03196

## 2F. Groundwater

**INVESTIGATION INTO THE EFFECT OF DIFFERENT PUMPING REGIMES ON DRAWDOWN IN LARGE DIAMETER WELLS,**
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W85-02826

**MODELLING APPROACH TO ESTIMATING AQUIFER RECHARGE ON A REGIONAL SCALE,**
Institute of Hydrology, Wallingford (England).
R. S. Wikramaratna, and C. E. Reeve.
Hydrological Sciences Journal, Vol. 29, No. 3, p 327-337, 1984. 5 Fig, 3 Ref.

Descriptors: *Aquifers, *Groundwater recharge, *Model studies, Hydrologic models, Mathematical studies,.

A method is proposed which is a generalization of the inferred recharge model developed by Smith and Wikramaratna (1981, Hydrol. Sci. Bul. 26(2), 113-136). Two of the proposed extensions to the original model, the fitting of water levels at data points and the weighting of errors to reflect the confidence in water level observations, are designed to make the model more directly applicable to field data. The third extension involves the introduction of the concept of recharge types. This makes the model more applicable to practical problems since it overcomes the major limitation of the original inferred recharge model and allows more direct comparison between model and water balance results. In most cases the variance of the recharge error is reduced by using the modified model. Where sufficient information is available concerning the recharge patterns, the modification may lead to an improvement in the recharge estimates. (Baker-IVI)
W85-02830

**EFFECT OF URBANIZATION IN AN ARID REGION: FORMATION OF A PERCHED WATER TABLE THAT CAUSES ENVIRONMENTAL DAMAGES,**
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
A. Karnieli, A. Issar, and M. Wolf.
Environmental Geology and Water Sciences, Vol. 6, No. 1, p 51-63, 1984. 13 Fig, 2 Tab, 19 Ref.

Descriptors: *Israel, *Dimona, *Urbanization, *Perched water table, Environmental effects, Groundwater, Flooding.

Construction in a new neighborhood in the Israeli town of Dimona, situated in an arid region in the south of the country (150 mm average annual rainfall), resulted in a rise in groundwater levels during the subsequent rainy seasons. This caused flooding of shelter basements, soil sliding, and sagging which permanently damaged walls and buildings. The neighborhood had been built on continental sands and marls blanketed by loess, on a valley slope near a rocky anticlinal dip-slope. Subsurface studies, using piezometer holes and groundwater analyses, revealed the presence of sand lenses alternating with plastic marls, which act as seasonal aquifers with perched water tables. Groundwaters obtain high SO4(-2) and Cl(-) corrosivity through contact with these nonflushed marls of the Neogene valley fill (Hazeva Formation). The reasons for the rising of groundwater were found to be: (a) artificial interference with the natural (pre-construction) drainage system-interception of the hillside runoff by building plots, roads, etc.; (b) partial denudation of the loess blanket, increasing the local infiltration and the build-up of local, perched water tables; and (c) corrosion of concrete and steel pipelines, as well as foundations, by prolonged contact with corrosive groundwater, resulting in haphazard but massive leakage. An environmental improvement plan was proposed which would include: terracing and planting of the watershed above town to increase evapotranspiration; lowering of the water table by pump-

ing, and diverting the water to suburban parks (groves of salt-resistant trees); and replacement of steel and cement pipes by a non-corrodable plastic pipe system. (Author's abstract)
W85-02862

**USE OF PUMPING TESTS TO EVALUATE A GEOTHERMAL RESERVOIR - THE TRIASSIC SANDSTONES AT MARCHWOD, SOUTHAMPTON,**
British Geological Survey, London (England). Aquifer Properties Section.
M. Price, and D. J. Allen.
Proceedings of the Institution of Civil Engineers, Vol. 76, Part 1, p 697-711, August, 1984. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *England, *Southampton, *Marchwood, *Geothermal Resources, Gas lifts, Transmissivity, Exploration.

The first geothermal exploration borehole in the UK was completed in March 1980. Preliminary investigations using geophysical logging, laboratory studies of cores, and drill-stem tests indicated that the borehole had encountered a potential geothermal reservoir in the Triassic sandstones. This Paper describes the pumping tests which formed the next stage in the evaluation of the reservoir. A preliminary test, using gas lift, was carried out with the drilling rig still on site; the results indicated that a longer test was justified, and also provided data with which a pump could be specified. The depth of the well, variations in the temperature (and hence density) of the water column, and the lack of observation wells provided an unusual set of conditions for a water-well test. The Paper discusses these conditions and the methods used to deal with them. The reservoir was shown to have a transmissivity of about 7 sq m/day, with leakage effects and a hydraulic boundary present. (Author's abstract)
W85-02949

**SOLUTE TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS,**
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Journal of Fluid Mechanics, Vol. 145, p 151-177, August, 1984. 7 Fig, 20 Ref.

Descriptors: *Solute transport, *Porous media, Fluid mechanics, Permeability coefficient, Transmissivity, Velocity, Groundwater movement, Hydraulic head.

Solute transport in porous formations is governed by the large scale heterogeneity of hydraulic conductivity. A first order perturbation approximation, valid for small log-conductivity variance, is used in order to derive closed form expressions of the Eulerian velocity covariances for uniform average flow. The variance of the space-averaged concentration over a volume V may be quite large unless the length scale of the initial solute body or of V is large compared with the conductivity intergral scale. This condition is bound to be obeyed for transport at the local scale, in which case the concentration may be assumed to satisfy the erogodic hypothesis. This is not generally the case at the regional scale, and the solute concentration is subjected to large uncertainty. The usefulness of the prediction of the concentration expectation value is then quite limited and the dispersion coefficients become meaningless. The influence of knowledge of the conductivity and head at a set of points upon transport is also examined. The statistical moments of the velocity and concentration fields are computed for a subensemble of formations and for conditional probability distribution functions of conductivity and head, with measured values kept fixed at the set of measurement points. Measurements of transmissivity on a grid of points can be effective in reducing concentration variance, provided that the distance between the points is smaller than two conductivity integral scales. Head conditioning has a lesser effect on variance reduction. (Baker-IVI)
W85-03036

**SIMILARITY AND ITERATIVE SOLUTION OF THE BOUSSINESQ EQUATION,**
Thessaloniki Univ., Salonika (Greece). School of Technology.
E. G. Sidiropoulos, and P. K. Tolikas.
Journal of Hydrology, Vol. 74, No. 1/2, p 31-41, October, 1984. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Boussinesq equation, *Groundwater movement, Diffusion, Heat conduction, Mathematical equations, Differential equations, Surface-groundwater relations.

The one-dimensional Boussinesq equation is used to describe groundwater flow from a stream to an aquifer due to sudden raising of the stream level. Applications are also noted in diffusion and heat conduction problems with a step-function increase in their boundary values. Through the Boltzmann transformation an ordinary nonlinear differential equation and a two-point boundary value problem is obtained, which is solved by means of shooting iterations. Qualitative considerations permit the construction, through fitting, of an analytical curve that provides an estimate of the slope at the origin, needed for the first shooting iteration. A new formula is proposed for the slope needed in the second iteration. Finally, an algorithm is given that produces first- and second-order corrections to the previous slope estimates until the solution given by the Runge-Kutta scheme yields the desired value at infinity. The latter estimated combined with the iterative scheme remove the necessity of large numbers of shooting iterations. (Author's abstract)
W85-03080

**RECHARGE TO AQUIFERS WITH MIXED BOUNDARIES,**
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
N. H. Rao, and P. B. S. Sarma.
Journal of Hydrology, Vol. 74, No. 1/2, p 43-51, October, 1984. 4 Fig, 8 Ref.

Descriptors: *Groundwater recharge, *Aquifers, Boundary conditions, Fourier analysis, Mathematical studies, Strip basin recharge, Surface-groundwater relations.

The response to unconfined aquifers to localized recharge is of importance in the evaluation and development of groundwater resources. The feasibility of solving directly the mixed-boundary problem of groundwater recharge processes is examined using extended finite Fourier transformation. The analytical procedure is developed for the one-dimensional problem of strip basin recharge to an unconfined aquifer bounded by an impermeable wall on one side and a stream at the other. The analytical problem was also solved by the method of images using the solutions derived earlier for finite aquifers with impermeable boundaries. The solutions resulting from the two procedures were identical. It is easy to extend the procedure to two- and three-dimensional problems. (Moore-IVI)
W85-03081

**COMPUTATION OF THE UNSTEADY TWO-DIMENSIONAL FREE SURFACE OF GROUNDWATER BY THE FINITE-ELEMENT METHOD,**
Thessaloniki Univ., Salonika (Greece). Dept. of General and Agricultural Hydraulics and Reclamation.
D. Karamouzis, and G. Terzidis.
Journal of Hydrology, Vol. 74, No. 1/2, p 53-65, October, 1984. 5 Fig, 33 Ref.

Descriptors: *Groundwater movement, *Aquifers, *Finite-element method, *Free surfaces, Artificial recharge, Pumping, Mathematical studies, Groundwater recharge, Anisotropic aquifers, Nonhomogenous aquifers, Boundary conditions.

A numerical solution of unsteady two-dimensional groundwater flow in unconfined aquifers with pumping and/or artificial recharge is presented. Problems of nonhomogeneous and anisotropic aquifers with pumping wells and/or artificial recharge and of various type of boundary conditions are considered. A governing equation is formulated in terms of the finite-element process using the Galerkin approach and triangular elements in the x-y plane. The continuous time Galerkin approximation is used for the time dimension. The obtained nonlinear system of algebraic equations is solved by a predictor-corrector approximation. The results of the numerical solutions are presented in diagrams from which useful observations, comparisons and conclusions can be drawn. (Author's abstract)
W85-03082

**HYDROCHEMICAL BUDGETS FOR A MAGNESIAN LIMESTONE CATCHMENT IN LOWLAND ENGLAND,**
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W85-03083

**BACTERIOLOGICAL STUDY OF GEOTHERMAL SPRING-WATERS DATING FROM DOGGER AND TRIAS PERIODS IN THE 'BASSIN PARISIEN' (ETUDE BACTERIOLOGIQUE DES EAUX GEOTHERMALES DU DOGGER ET DU TRIAS DU BASSIN PARISIEN),**
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
S. Daumas, O. Goyeneche, and A. Bianchi.
Comptes Rendus Hebdomadaires de l'Academie Seances Paris, Series III, Vol. 299, No. 9, p 343-345, September, 1984. 1 Tab, 15 Ref.

Descriptors: *Geothermal water, *Bacteria, *Parisian Basin, *France, Anaerobic bacteria, Groundwater, Salts, Thermophilic bacteria, Thermal water, Aquifers.

The geothermal waters of the Dogger and Triassic periods of the Parisian Basin constitute an anoxic environment which maintains a temperature on the order of 70 C. The four geothermal sites are Melun, Cergy-Pontoise and Meaux from the Dogger, and Melleray from the Triassic. The water, with a salinity of 20-35 g/l, contains primarily sodium chloride (80%) and sulfates and carbonates. The gaseous phase is principally composed of N2, CO2 and CH4. The conditions permit the survival and proliferation of various types of bacteria which may provide evidence on the source of the water. The enumeration of the different physiological types of microbial communities detected in the groundwaters of the four geothermal sites reveals a predominance of anaerobic and thermophilic bacteria. The anaerobic microflora, though adapted to high temperatures, could have an autochthonous origin and exercise a metabolic effect on the conditions of the aquifer. (Moore-IVI)
W85-03111

**HYDROGEOLOGIC CHARACTERISTICS OF SHALLOW GLACIAL DRIFT AQUIFERS IN DISSECTED TILL PLAINS (NORTH-CENTRAL MISSOURI),**
Texas Univ. at Austin. Dept. of Geological Sciences.
J. M. Sharp, Jr.
Ground Water, Vol. 22, No. 6, p 683-689, November-December, 1984. 5 Fig, 1 Tab, 42 Ref.

Descriptors: *Iowa, *Nebraska, *Kansas, *Missouri, *Hydrogeology, Permeability coefficient, Aquifer characteristics, Glacial drift, Iron, Recharge, Brackish water.

The dissected till plains comprise an extensive area of Iowa, Nebraska, Kansas, and Missouri. The area is important agriculturally and for its coal resources. Water from bedrock formations is frequently too brackish for domestic or agricultural use. Hydraulic conductivity values within glacial drift showed two log-normal distributions, comprising a nonuniform, heterogeneous medium. Specific storage for nine samples of glacial till averaged .00382/m. This is somewhat less than values reported for younger clay-rich tills and may represent the effects of time-dependent consolidation. Water budget calculations for small drift-covered

watersheds indicate that approximately 70% of the precipitation discharges by evapotranspiration and 30% by stream flow. Each watershed contains its own groundwater flow system. Recharge is concentrated on the nearly horizontal hill summits and discharge by base flow and evapotranspiration is concentrated in stream channels. Recharge rates are directly proportional to shallow drift hydraulic conductivity, but the low conductivities impede recharge on hill shoulders, fore slopes, and back slopes to create greater surface-water runoff. Local flow systems show only minimal hydraulic connection to underlying bedrock formations or adjoining shallow drift aquifers. Ground water in the shallow drift systems is generally potable but may be high in iron or locally-derived organic pollutants. (Baker-IVI)
W85-03147

**HYDRAULIC PROPERTIES OF STONY VADOSE ZONES,**
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, and R. C. Rice.
Groundwater, Vol. 22, No. 6, p 696-705, November-December, 1984. 14 Ref, 1 Tab, 9 Ref.

Descriptors: *Vadose water, *Hydraulic properties, Soil properties, Saturated soils, Soil types, Unsaturated soils, Permeability coefficient.

Hydraulic properties of saturated and unsaturated stony soils were studied on a 3.35 m long column, 1.24 m in diameter, filled with alternating sand and boulder layers. The study showed that the saturated bulk hydraulic conductivity K of a stony soil can be calculated from the saturated K of the soil between the stones and the void ratios of the stony soil and the soil alone. The relation between the unsaturated K of stony soil and soil water pressure head h or bulk water content can be determined from the relation between K and h of the soil alone by moving the K vs. h curve of the soil alone down on the K vs. h graph on log-log paper until its saturated K coincides with the bulk saturated K of the stony soil. The bulk volumetric water content of the stony soil can be calculated by multiplying the volumetric water content of the soil alone by 1-Vr, where Vr is the volume fraction of the stones. The dispersivity Dy of a stony soil is greater than the dispersivity of the soil fraction alone. For the boulder-sand column, Dy was 18 times the Dy-value for the sand alone. Pore velocities or macroscopic velocities in stony soils can be calculated as the Darcy velocity divided by the volumetric water content. (Baker-IVI)
W85-03149

**AQUIFER CLASSIFICATION FOR THE UIC PROGRAM: PROTOTYPE STUDIES IN NEW MEXICO,**
Wilson (Lee) and Associates, Inc., Santa Fe, NM.
L. Wilson, and M. T. Holland.
Groundwater, Vol. 22, No. 6, p 706-716, November-December, 1984. 8 Fig, 17 Ref.

Descriptors: *Groundwater, *Aquifer characteristics, *New Mexico, *Underground injection, Geothermal studies, Model studies, Permeability coefficient, Evaluation.

Three case studies from New Mexico illustrate methods by which aquifers can be classified for purposes of the Federal Underground Injection Control program. The three studies demonstrate that it is practical but not simple to implement the aquifer classification component of the UIC regulations. Aquifer classification involves determining answers to the following questions: whether injection will be into or above the rock unit; whether the rock unit is now used as an USDW; whether the water in the rock unit contains less than 10,000 mg/l dissolved solids; whether the rock unit is an aquifer capable of yielding a significant amount of water to a well or spring; whether the aquifer is unusable as an USDW because it is mineral, hydrocarbon or geothermal energy producing, or because it is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical, or because it is so contaminated that it would be economically or technologically impractical to render it fit for human consumption, or because it is located over an area of in-situ mining subject to subsidence or catastrophic collapse; and whether the water in the aquifer contains more than 3,000 mg/l dissolved solids. Thus the classification relies upon hydrogeologic cross sections which reflect understanding of regional hydrology and geology and which use data obtained from well records and geophysical logs. The cost of a UIC aquifer classification should be in the range of $0.50 to $1.00 per square mile. (Baker-IVI)
W85-03150

**ROLE OF GEOLOGICAL AND GEOPHYSICAL DATA IN MODELING A SOUTHWESTERN ALLUVIAL BASIN,**
Stone and Webster Engineering Corp., Boston, MA.
K. M. O'Brien, and W. J. Stone.
Groundwater, Vol. 22, No. 6, p 717-727, November-December, 1984. 12 Fig, 27 Ref. US Geological Survey Agreement No 14-08-00001-18812.

Descriptors: *Alluvial aquifers, *Model studies, *New Mexico, *Animas Valley, Transmissivity, Gravity groundwater.

A parameter estimation technique based on existing hydrological, geophysical and geological data was developed to approximate transmissivity values for use in a ground water flow model of the Animas Valley, southwest New Mexico. Complete Bouguer gravity anomaly maps together with Seismic-refraction profiles, geologic maps, geologic, geophysical, and drillers' logs, water levels, and pumping test data provide insight into the transmissivity of bolson deposits throughout the basin. The transmissivity distribution was primarily based on reported pumping and specific-capacity tests in conjunction with complete Bouguer gravity anomaly maps and well log data. The relationship between gravity data and transmissivity data was used to approximate transmissivity values in grid blocks where transmissivity values are not available. A two-dimensional, finite-difference, groundwater flow computer code was used to evaluate the effectiveness of the parameter-estimation technique. The conceptually straightforward approach for parameter estimation using existing hydrological, geophysical, and geological data provided realistic parameter estimates. (Baker-IVI)
W85-03151

**EXPLICIT FINITE DIFFERENCE MODEL FOR UNCONFINED AQUIFERS,**
Washington Univ., Seattle. Dept. of Civil Engineering.
W.-S. Chu, and R. Willis.
Groundwater, Vol. 22, No. 6, p 728-734, November-December, 1984. 9 Fig, 1 Tab, 17 Ref.

Descriptors: *Unconfined aquifers, *Model studies, *Groundwater flow, Finite difference methods, Mathematical studies.

A simulation model for transient two-dimensional vertically averaged flow in an unconfined aquifer was successfully developed. The model solves the Boussinseq equation governing the water table variation in the aquifer. The nonlinear partial differential equation is solved by the simplest finite difference scheme - the forward in time, central in space explicit method without any matrix solver. Although the method is known to have a fairly restrictive stability condition, it was shown that the condition is not a significant limiting factor for short-term real-time simulations. The accuracy of the code was tested by comparing results with an analytical solution. All of the head values predicted by the model compared closely to the analytical solution. The model was also tested using realistic data for Blue Lake Aquifer in Northern California. The aquifer parameters are determined partly from a small number of well logs and cross-sectional surveys, and partly from water-level data taken from small, privately-owned service wells. Through the comparison of model simulation results and limited observations, it was possible to identify certain trouble spots in the aquifer. The results indicate that besides the river stage and water table information, special attention should be directed toward data collection in the southeastern portion of the aquifer. This exercise showed that the use of simulation models does not have to be constrained by limited data, and that models can be used as an aid to identify locations where additional data should be collected. (Baker-IVI)
W85-03152

**INTEGRATED HYDROCHEMICAL APPROACH TO DEDUCE THE RESPONSE OF AN AQUIFER SYSTEM DURING ITS HISTORY OF ABSTRACTION,**
Birmingham Univ. (England). Dept. of Civil Engineering.
D. Jackson, and J. W. Lloyd.
Groundwater, Vol. 22, No. 6, p 735-745, November-December, 1984. 6 Fig, 6 Tab, 7 Ref.

Descriptors: *Aquifer characteristics, *Groundwater flow, Isotope studies, Chalk aquifer, England, Chemical analysis, Water analysis.

The investigation of the regional flow characteristics of aquifers is important with respect to aquifer management. To determine regional flows, use can be made of hydraulic and hydrochemical data. In a study of a Chalk Aquifer System in the south of Lincolnshire, England, a combined hydrochemical approach using major, minor and isotope chemistry is described. In the north, two preferential replenishment flow paths are operative on either side of a low flow zone of high iodide, relatively old ground waters. These ground water flow paths are contributing ground water to the abstraction area. The buried cliff in the central area acts as a very effective barrier to east-west flow restricting any movement of modern recharge water into the abstraction area. In the south, replenishment to the abstraction by ground-water flow from the Carstone appears dominant. This case study provides a good example of the use of multiparameter chemical interpretation in hydrogeological studies. The approach has particular advantages where hydraulic data are limited, groundwater head data show little variation, and/or complex hydrogeology occurs. (Baker-IVI)
W85-03153

**COMPARATIVE STUDY OF SPECIFIC YIELD DETERMINATIONS FOR A SHALLOW SAND AQUIFER,**
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
G. I. Nwankwor, J. A. Cherry, and R. W. Gillham.
Groundwater, Vol. 22, No. 6, p 764-772, November-December, 1984. 8 Fig, 1 Tab, 20 Ref.

Descriptors: *Sand aquifers, *Specific yield, Unconfined aquifers, Pumping, Hydraulic gradient, Water table, Drawdown.

Using the type-curve methods of Boulton (Boulton, N.S., 1963. Proc. Inst. Civil Engr. V. 26, p 469-482) and Neuman (Neuman, S.P., 1972. Water Resourc. Res. V. 8, No. 4, p 1031-1044.), and comparisons, at various times, of the cumulative volume of water pumped to the volume of the water-table drawdown cone, values of specific yield were obtained from pumping test data from numerous piezometers in an unconfined sand aquifer. The long term value of specific yield for the aquifer was determined from measurements of the laboratory drainage curve of the aquifer material. The values of specific yield and volume balances show large differences. The laboratory drainage curve indicates that the long term specific yield of the aquifer is about 0.30. The volume-balance method provided values of specific yield that are much lower than the long term value. However, the values increase with increasing duration of pumping, and closely approach the laboratory-determined value after two and one-half days. This trend indicates that delayed drainage from above the water table is an important process influencing the response of the aquifer system. The Boulton and Neuman type curve methods give almost identical results, and although the computed values of transmissivity are reasonable, the values of specific yield are about one-third the late time values ob-

tained from the volume-balance and laboratory methods. Thus is appears that the type curve models provide values of specific yield that are not suitable for use in the context of long term aquifer yield analysis, and that using the volume-balance method at late time or the laboratory method provides a more reasonable estimate of the long term specific yield of this aquifer. However, the Boulton and Neuman models lack an apparently important process, either vertical flow in the saturated zone which is not included in the Boulton model, or delayed drainage from above the water table, which is not accounted for in the Neuman model. (Baker-IVI)
W85-03156

**COMPUTING DRAWDOWN DISTRIBUTION USING MICROCOMPUTERS,**
GAI Consultants, Inc., Monroeville, PA.
J. M. King.
Groundwater, Vol. 22, No. 6, p 780-784, November-December, 1984. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Drawdown, *Computers, Microcomputers, Transmissivitiy, Storativity, Data processing, Groundwater management, Groundwater movement.

Using known or estimated values of transmissivity and storativity, the distribution of drawdowns at any time within a discretized flow field can be generated by applying simple trigonometry and numerical approximations of the exponential integral to the Theis equation. Single- and mutiple-well systems, as well as image boundaries, are readily simulated with this method. An interactive BASIC program is described with a great deal of utility for examining pumping and boundary effects in studies which do not warrant a more complex numerical model. The program uses known or estimated aquifer parameters to compute the drawdown at every point in a grid representing the area of influence in a confined aquifer. It determines the drawdown distribution resulting from a single well or the combined effects of several interfering wells and is capable of simulating moderately complex combinations of recharge and discharge boundaries using image-well theory. A version of the code is listed in the Appendix which is efficient, has minimal memory requirements, and is fully compatible with TRS-80 Model III and Model 4 microcomputers. It is useable with many other small computers in its present form or can be made so with only slight modifications. (Baker-IVI)
W85-03157

**ANALYSIS OF DISPERSION IN A STRATIFIED AQUIFER,**
Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven, F. J. Molz, and J. G. Melville.
Water Resources Research, Vol. 20, No. 10, p 1337-1354, October, 1984. 14 Fig, 1 Tab, 43 Ref.

Descriptors: *Permeability coefficient, *Dispersion, *Stratified aquifer, Aquifers, Aquifer characteristics, Groundwater flow.

The dispersion of a conservative solute produced as a result of vertical variations of hydraulic conductivity in a horizontal stratified aquifer of finite thickness is analyzed by applying the moment method of Aris to solve the governing advection-dispersion equation describing mass transport. It is assumed in the analysis that the aquifer is of constant thickness and of infinite lateral extent, the hydraulic conductivity is a known function of the vertical coordinate only, and the flow is unidirectional, parallel to the stratification. The applicable Aris moment equations are developed in a suitable nondimensional form. Analytical solutions are obtained for the zeroth and first moments and for the time derivative of the second moment of the longitudinal concentration distribution for the case of an instantaneous plane source for several idealized hydraulic conductivity profiles. The analysis gives the time-dependent variation of the longitudinal macrodispersivity for these idealized cases throughout the transient development of the dispersion process. The results of the analysis are applied to a field-measured hydraulic conductivity profile, and predicted values of the longitudinal macrodispersivity are compared with field results. An important conclusion from the analyses is that nonuniformities in the hydraulic conductivity profile which persist over long distances may produce rather large values of longitudinal macrodispersivity which compared to those observed in some aquifers and which are much larger than those predicted by some previous stochastic analyses. The present results support that the vertical profile of hydraulic conductivity is a very important factor in the determination of longitudinal macrodispersivity and of the transient development of the dispersion process in general. Hence, in any major field study involved with contaminant transport in an aquifer, an effort should be made to obtain detailed measurements of the vertical profiles of hydraulic conductivity at several locations in the aquifer. (Baker-IVI)
W85-03160

**MODEL FOR INVESTIGATING MECHANICAL TRANSPORT IN FRACTURE NETWORKS,**
California Univ., Berkeley. Lawrence Berkeley Lab.
H. K. Endo, J. C. S. Long, C. R. Wilson, and P. A. Witherspoon.
Water Resources Research, Vol. 20, No. 10, p 1390-1400, October, 1984. 14 Fig, 2 Tab, 18 Ref.

Descriptors: *Fracture permeability, *Geologic fractures, *Path of pollutants, Permeability, Porosity, Groundwater flow, Transport.

Directional mechanical transport properties for anisotropic fracture systems were investigated. A determination was sought of when fracture systems can be treated like equivalent porous media in transport studies and a model that simulated mechanical transport in networks of fractures is introduced. The two important conditions necesary for measuring directional mechanical transport for an equivalent porous medium are a uniform flow field and a test section where the linear path length is constant. With these two conditions satisfied, mechanical transport parameters can be measured from the breakthrough curve for the fluid that flows within the test section. The hydraulic effective porosity was defined as the ratio of specific discharge to average linear velocity. In porous media transport studies, hydraulic effective porosity is directionally stable. Thus the shape of the polar plot of hydraulic effective porosity was used to test whether a fracture system behaved like an equivalent porous medium for transport. A numerical model was developed to simulate mechanical transport under steady flow in a network of fractures. The model incorporated the principles of laminar flow to calculate the location of streamtubes for fluid flowing from one side of a flow region to another. The model has been used to simulate mechanical transport in regular, anisotropic systems of continuous fractures. The results demonstrated that a fracture system which behaves as a continuum for fluid flux may not behave as a continuum for mechanical transport. (Baker-IVI)
W85-03163

**INTERPRETATION OF DOWNHOLE DATA AND DEVELOPMENT OF A CONCEPTUAL MODEL FOR THE REDONDO CREEK AREA OF THE BACA GEOTHERMAL FIELD,**
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
For primary bibliographic entry see Field 6B.
W85-03164

**UNSTEADY SHALLOW GROUNDWATER FLOW OVER A CURVED IMPERMEABLE BOUNDARY,**
New South Wales Univ., Kensington (Australia). Dept. of Civil Engineering.
T. G. Chapman, and R. F. Dressler.
Water Resources Research, Vol. 20, No. 10, p 1427-1434, October, 1984. 7 Fig, 12 Ref. US National Science Foundation Grant CEE-8210793.

Descriptors: *Groundwater flow, *Mathematical equations, Permeability, Porosity, Diffusion.

The asymptotic method which produced the new Dressler equation for curved open channel hydraulic flow is employed here to obtain analogous equations for unsteady, two-dimensional, free surface groundwater flow over an arbitrarily curved bed. The result is a pair of partial differential equations: the first linear, stemming from Darcy's Law, and the second nonlinear, expressing mass conservation. The hydraulic conductivity and porosity can be functions of position. The flow component above and parallel to the bed behaves as a vortex in the small with centrifugal acceleration but with no centrifugal term in the pressure. For the special case of a plane sloping bed these equations reduce to the Wooding-Chapman extension of the Dupuit-Forchheimer equations. The two-dimensional flow equations are generalized to a special case of a nonisotropic medium and to include the effect of a variable recharge rate. All the systems are parabolic, thus describing diffusion, and can be integrated numerically as readily as the simpler equations for plane beds. (Baker-IVI)
W85-03166

**MIGRATION OF RADIONUCLIDES IN FISSURED ROCK: ANALYTICAL SOLUTIONS FOR THE CASE OF CONSTANT SOURCE STRENGTH,**
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
A. Rasmuson.
Water Resources Research, Vol. 20, No. 10, p 1435-1442, October, 1984. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Groundwater flow, *Radionuclides, *Migration, *Geologic fractures, Permeability coefficient, Model studies, Transport.

An analytical solution has been developed for the migration of radionuclides in fissured rock. The solution differs from a previously derived solution in the inlet boundary condition. The solution developed here is considerably more complicated. Processes that are accounted for are advection and longitudinal dispersion in the fissures, external and internal diffusion into spherical rock blocks, sorption onto the fissure surfaces, and sorption within the matrix and radioactive decay. The solution is obtained in the form of an infinite single integral depending in general on six dimensionless parameters. After long times a steady state condition is obtained, which in general includes five dimensionless quantities. A comparison with previously published results for a system of parallel fractures is made. It is shown that if the area to volume ratio of the slabs and the spherical rock blocks are the same, identical breakthrough curves are produced for short and long contact times. In the intermediate range the solution with spherical rock blocks will give earlier breakthrough and higher steady state concentrations. (Baker-IVI)
W85-03167

**REINVESTIGATION OF THE ANALYTICAL SOLUTION FOR DRAWDOWN DISTRIBUTIONS IN A FINITE CONFINED AQUIFER,**
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
C.-S. Chen.
Water Resources Research, Vol. 20, No. 10, p 1466-1468, October, 1984. 1 Fig, 10 Ref.

Descriptors: *Confined aquifers, *Drawdown, Aquifers, Mathematical equations, Laplace equation.

A finite aquifer is an aquifer in which drawdown variations reflect the influence of the exterior boundary. On the basis of a number of relations existing in groundwater hydraulics the analytical solution for drawdown distributions in a finite confined aquifer is reinvestigated and obtained. The development of the solution was facilitated by using the available steady state solution for drawdown distributions in a leaky artesian aquifer with constant leakage. A time relation is determined identifying the duration during which an ideal aquifer (that is, an aquifer which is homogeneous, isotropic, and of uniform thickness) can be approached as an infinite one. The solution obtained

consists of the Theis solution and other functions which are responsible for the influence of the exterior boundary. Methods of evaluating the solution are given, and results are presented in type curves. (Baker-IVI)
W85-03170

ELECTRICAL RESISTIVITY STUDIES TO DELIMIT ZONES OF ACCEPTABLE GROUND WATER QUALITY,
Geo-Recon International Ltd., Seattle, WA.
For primary bibliographic entry see Field 2B.
W85-03176

SEISMIC AND RESISTIVITY INVESTIGATIONS NEAR NORWAY, MICHIGAN,
J. E. Underwood, K. J. Laudon, and T. S. Laudon.
Ground Water Monitoring Review, Vol. 4, No. 4, p 86-91, Fall, 1984. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Groundwater, *Monitoring, *Michigan, *Maps, Topography, Menominee River, Floodplains, Cost analysis.

Reconnaissance geophysical surveys of a small area near Norway, Michigan were conducted on April 24 and 25, 1982, using seismic refraction and electrical resistivity methods. Information gained from these surveys was used to evaluate the ground water supply potential of a specific site selected by the Norway, Michigan Water Commission. The specific objectives of the study were to collect seismic refraction data and electrical resistivity data, interpret the data when possible to delineate the configuration of the bedrock surface, the thickness and charactistics of the overlying sediments, the depth to the water table, and other vertical and lateral variations within the sediment column that have either electrical or seismic expression. Groundwater flow in the area interpreted from the contour map of water table elevations is toward the south-southeast. This geophysical survey proved to be a cost-effective tool in siting a municipal well for the city of Norway. Considerable time and money were saved by conducting the test drilling program based on the results of the geophysical investigation. (Baker-IVI)
W85-03179

TESTING AND SAMPLING OF DEEP BRINE AQUIFERS IN THE PALO DURO BASIN, WEST TEXAS,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
M. A. Deyling.
Ground Water Monitoring Review, Vol. 4, No. 4, p 147-151, Fall, 1984. 8 Fig, 5 Ref.

Descriptors: *Aquifers, *Water analysis, *Brine, *Texas, *Palo Duro Basin, Aquifer properties, Hazardous materials, Underground storage, Nuclear wastes, Test wells, Sampling.

The US Department of Energy is investigating the Palo Duro Basin of West Texas along with locations in Nevada, Washington, Utah, Mississippi and Louisiana as potential sites for storage of high-level nuclear waste. Ten wells have been drilled to depths between 3,000 and 8,300 feet. Testing and sampling of deep test zones requires advance planning and analysis of what must be obtained from the well. Various alternatives are available depending on data needs. In this particular instance, both hydrologic and geochemical data were required. The methods chosen were field proven methods used in the oil field industry for many years. Short term testing has included conventional oil-field-type drill stem tests and drill stem equipment with surface pressure readout. Long term testing has consisted of a series of production and recovery tests. Fluid sampling was performed in two stages. The first was at the well head under an imposed pressure of several hundred psi. The second fluid samples were collected downhole at the production zone under pressures close to ambient pressure. The geochemical data and hydrologic data can be used as independent checks on each other in many cases. Test results from the well along with examination of recovered core provided maximum data for each well. (Baker-IVI)
W85-03187

SURFACE AND BOREHOLE GEOPHYSICAL METHODS IN GROUND WATER INVESTIGATIONS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
J. T. Mickam, B. S. Levy, and G. W. Lee, Jr.
Ground Water Monitoring Review, Vol. 4, No. 4, p 167-171, Fall, 1984. 3 Fig, 2 Tab.

Descriptors: *Groundwater, *Monitoring, *Geophysics, Groundwater flow, Boreholes, Geological fractures, Karst hydrology, Gamma ray logs, Borehole caliper logs.

Natural gamma ray and hole caliper borehole logs appear to be effective tools enhancing the geologist's understanding of the subsurface. They can be effective in karst terranes because they have the ability to discriminate between the primary limestone formation and the less abundant shale and clay horizons as well as being able to detect fractures and solution features. The use of natural gamma ray and hole caliper borehole logs is advantageous because the associated equipment is portable and, therefore, does not limit the operation to vehicle accessible sites; they supply an alternative means of acquiring data and thus enable the investigator to employ a drilling method less costly than continuous coring; the interpretation is direct and qualitative, which avoids complicated data reduction. Four general log signature deviation patterns can be identified and modeled to interpret: clay lined fractures and solution channels or washed-out clay or shale horizon, hydrated shale or clay horizons, open fractures or solution channels, and solution development along lithologic change contacts. (Baker-IVI)
W85-03189

APPLICATION OF TELEVISION BOREHOLE LOGGING TO GROUND WATER MONITORING PROGRAMS,
Hart (Fred C.) Associates, Inc., New York.
T. Morahan, and R. C. Dorrier.
Ground Water Monitoring Review, Vol. 4, No. 4, p 172-175, Fall, 1984. 5 Fig.

Descriptors: *Boreholes, *Groundwater, *Monitoring, *Television, Borehole logging, Geophysics, Wells, Groundwater pollution, Water pollution control, Geological fractures.

Borehole television surveys have recently been used to gather in situ information on boreholes and wells in subsurface investigation phases of ground water monitoring programs. Recent high tech developments have led to the miniaturization of the borehole television camera. The lens attachments in the system described are capable of looking sideward or downward and include built-in lighting assemblies. Use of the camera, lenses and various support equipment are discussed. The in situ characterization of fractures that can provide pathways for contaminant migration poses a significant challenge. Borehole television inspection can provide information on the frequency, size and orientation of these fractures. Vertical correlations of rock cores in areas where voids are present can also be simplified by this technique. In addition, borehole television can also be used to check monitoring well integrity. Casing inspections are especially useful where construction details are not known. Well screens may be inspected in place to determine if rusting has enlarged the screen openings or if screens have been damaged during emplacement or well development operations. This information may be valuable in the decision to decommission a well. This has been successfully applied in ground water monitoring programs at several Superfund hazardous waste sites. (Baker-IVI)
W85-03190

MONITORING IN THE VADOSE AND SATURATED ZONES UTILIZING FLUOROPLASTIC,
Timco Mfg., Inc., Prairie du Sac, WI.
For primary bibliographic entry see Field 7B.
W85-03192

DARCIAN FLOW CHARACTERISTICS UPGRADIENT OF A KETTLE POND DETERMINED BY DIRECT GROUND WATER FLOW MEASUREMENT,
K-V Associates, Inc., Falmouth, MA.
W. B. Kerfoot.
Ground Water Monitoring Review, Vol. 4, No. 4, p 188-192, Fall, 1984. 5 Fig, 3 Tab, 7 Ref.

Descriptors: *Groundwater movement, *Monitoring, *Flax Pond, *Massachusetts, *Darcy's Law, Flow, Kettle ponds, Surface-groundwater relations.

The study of the upgradient region of Flax Pond, Cape Cod, Massachusetts, and its immediate shoreline demonstrates that the zone of contribution can be accurately determined by direct ground water flow measurement combined with head gradient determinations. The components of the Dacian equation can also be conveniently plotted on a triaxial graph for measurements of velocity and head potential observed between wells across the region. The total volume of ground water discharged to the lake must be determined by vertical profiling since the velocities are highest at shallower depths. The immediate boundary condition of rapid change of head gradient at the shoreline combined with some sealing of the bottom deposits with fine sediments probably contributes to the inching of flow toward the shallow elevations. Linear projections of the rate of vertical movement, based upon a field porosity of 25% and a recharge rate of 18 inches of rainfall per year, combined with a horizontal transport velocity obtained from direct flow measurements can be used to define the zone of contribution. Shallow measurements of the direct and rate of ground water flow around the shoreline serve to define the locations of recharge and discharge. The area of the zone of contribution determined from volume discharge corresponds to that projected from direct shoreline flow measurements when the mean flow is adjusted to the mean depth of the pond. (Baker-IVI)
W85-03193

DIRTY-WATER EVENTS AT ROCKY MOUNTAIN HOT SPRINGS AND THEIR CORRELATION WITH OTHER SHORT-LIVED PHENOMENA,
National Hydrology Research Inst., Calgary (Alberta).
R. O. van Everdingen.
Canadian Journal of Earth Sciences, Vol. 21, No. 9, p 997-1007, September, 1984. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Earthquakes, *Storms, *Dirty-water events, *Radium Hot Springs, *British Columbia, *Miette Hot Springs, *Alberta, Hot springs, Hydrogen sulfide, Suspended solids, Rainfall, Dissolved solids, Sulfur.

Earthquakes in Montana, Idaho, and Alaska may trigger dirty-water events at both Miette and Radium hot springs. Earthquakes on the Pacific side of the cordillera apparently require larger magnitudes to trigger such events. The earthquake-triggered events are primarily characterized by the occurrence of sediment in the spring waters. Rainfall of 34 mm or more within 48 hr may induce a dirty-water event at Miette Hot Springs; however, precipitation exceeding this rate will not necessarily produce such an event. The rainfall-induced events are characterized by the occurrence of sediment contamination and by decreases in spring-water temperatures and changes in dissolved-solids content. The latter effects reflect mixing of thermal water with cooler, near-surface water with a lower mineral content and different composition. Associated decreases in water temperatures and dissolved-solids concentrations and changes in the ionic and isotopic compositions of the spring waters result from mixing of deep thermal water with cooler, less mineralized shallow water. By contrast, the earthquake-triggered events did not have significant thermal or geochemical effects. Suspended solids in the dirty waters represent surficial material and possibly residues from dissolution of carbonate rocks. At Miette Hot Springs the dirt contains secondary sulfur species (native sulfur

and gypsum) derived from the hydrogen sulfide content of the spring water. (Baker-IVI)
W85-03194

GROUNDWATER HYDRAULICS OF SEASONAL FROST MOUNDS, NORTH FORK PASS, YUKON TERRITORY,
Ottawa Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W85-03198

WATER-ROCK INTERACTION AND CHEMISTRY OF GROUNDWATERS FROM THE CANADIAN SHIELD,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2K.
W85-03205

HELIUM AND NEON ISOTOPE GEOCHEMISTRY OF SOME GROUND WATERS FROM THE CANADIAN PRECAMBRIAN SHIELD,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W85-03210

HELIUM AND NEON ISOTOPE GEOCHEMISTRY OF SOME GROUND WATERS FROM THE CANADIAN PRECAMBRIAN SHIELD,
National Hydrology Research Inst., Ottawa (Ontario).
D. J. Bottomley, J. D. Ross, and W. B. Clarke.
Geochimica et Cosmochimica Acta, Vol. 48, No. 10, October, 1984. 10 Fig, 4 Tab, 36 Ref.

Descriptors: *Isotope studies, *Groundwater dating, *Helium isotopes, *Neon isotopes, *Precambrian Shield, Porosity, Uranium, Thorium, Geochemistry, Geological fractures.

Studies which have applied several groundwater age dating techniques simultaneously report that the helium technique often appears to overestimate the age of groundwater. The origins of noble gas data collected from boreholes during the course of hydrogeochemical investigations at two of the several research areas on the Canadian Precambrian Shield are considered. Large concentrations of helium are present in all the area groundwaters. The highest helium concentrations are accompanied by radiogenic Ne-21 and Ne-22. Since U enrichment exists on at least some fracture surfaces of the flow porosity in the Lac du Bonnet batholith it is suspected that most of the He and Ne is produced in or immediately adjacent to the flow porosity. Helium and neon ages calculated by substitution of total porosity and bulk rock uranium and thorium concentrations into the helium age dating equation yield unreasonably high ages. Helium dating of ground waters in fractured igneous rocks will rarely be straightforward. In areas where uranium enrichment is present in the secondary minerals of water transmitting fractures, flow porosity and representative U and Th concentrations in the fractures must be used in the helium age dating equation. In other areas primary uranium mineralization in pegmatitic veins and dikes may enhance production in otherwise average granitic rocks. Failure to consider either source of uranium enrichment could result in gross overestimations of groundwater ages. (Baker-IVI)
W85-03210

## 2G. Water In Soils

MEASUREMENT OF SOIL WATER CONTENT USING A PORTABLE TDR HAND PROBE,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, J. L. Davis, W. G. Bailey, and W. D. Zebchuk.
Canadian Journal of Soil Science, Vol. 64, No. 3, p 313-321, August, 1984. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Soil water, *Measuring instruments, *Time-domain reflectrometry, Volumetric analysis, Gravimetry.

The time-domain reflectrometry (TDR) technique had previously been shown to measure the volumetric water content of soil accurately when applied to long-term installations of parallel transmission lines. In this study a hand probe was used with a portable TDR instrument to measure water content of soil down the wall of soil pits to a depth greater than 1 m. For the data from the soil pits there is no measurable difference between TDR measured water content and those measurements from gravimetric samples. There is a slight indication of location dependence. In a separate experiment the water content of the surface soil at two sites was measured repeatedly in increasing depth increments of 50 mm to 300 mm. The TDR measured values were compared with values obtained by a gravimetric determination on a sample of soil. The TDR gave values that were calculated at the time of measurement in the field. TDR measured values were as accurate and precise as those from gravimetric samples. A portable TDR instrument applied to a hand probe in the form of a parallel pair transmission line apparently gives an accurate and rapid measurement of soil-water content. For lengths of probes 10 mm or more the TDR and gravimetric method gave equal values. The TDR values were available immediately for improved interpretations of the soil properties and for guiding other experimental procedures. (Baker-IVI)
W85-02801

INFLUENCE OF WATER TABLE AND ATMOSPHERIC CO2 CONCENTRATION ON THE CARBON BALANCE OF ARCTIC TUNDRA,
Clemson Univ., SC. Dept. of Biological Sciences.
K. M. Peterson, W. D. Billings, and D. N. Reynolds.
Arctic and Alpine Research, Vol. 16, No. 3, p 331-335, August, 1984. 3 Tab, 16 Ref. NSF grant DEB-8193490 and DEB-8021312.

Descriptors: *Carbon balance, *Tundra, *Water table, *Carbon dioxide, Grasses, Cycling nutrients, Peat, Microbial degradation.

Carbon balance of intact arctic tundra microcosms (soil cores with vegetation) has been shown to be sensitive to small changes in water table. The persistence of the effect of water table on CO2 flux in darkness, and the large reduction of such an effect in sand-culture microcosms without peat-degrading microorganisms have led to the conclusion that rates of microbial degradation of peat are most likely responsible for the bulk of previously observed effects of water table on net ecosystem CO2 flux of arctic tundra microcosms. In an experiment using sand cultures, no significant effects of changes in water table or of increasing the atmospheric CO2 concentration on the growth of plants was detected in two dominant graminoid species (Dupontia fisheri and Carex aquatilis). (Author's abstract)
W85-02857

DEVELOPMENT AND VALIDATION OF A NUMERICAL MODEL SIMULATING EVAPORATION FROM SHORT CORES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, and G. K. Walker.
Soil Science Society of America Journal, Vol. 48, No. 5, p 960-969, September/October 1984. 5 Fig, 3 Tab, 47 Ref.

Descriptors: *Model studies, *Evaporation, *Soil moisture, Evaporimeter, Soil surfaces, Soil drying, Mathematical analysis.

A theoretically-based assessment of the short core evaporimeter technique for measuring evaporation from the soil surface can be conducted using numerical simulation. As an initial step, a numerical model is developed that simulates evaporation from isothermal, homogeneous, finite soil columns with a specified initial water content profile. Features of this model include nonlinearized solution of the highly nonlinear surface boundary condition, automatic adjustment of time-step size according to a mass balance criterion, remaximization of program efficiency at each time-step, and the use of soil surface temperature as the primary forcing function. The validity of the model was established through its ability to realistically simulate the constant and falling rate stages of soil drying, including root-time behavior, and by its good mass conservation and stability characteristics. Drying of a clay soil with an initial uniform water content of 0.40 (cu cm sub w)/(cu cm sub pm) for 12,000 min under a constant evaporative demand of 0.00044 (cu cm sub w)/(sq cm sub pm)/min could be simulated with a time-step size ranging from 10 to 13.7 min, a specific mass (i.e. flux) balance of $< 3\%$, a cumulative mass balance of $< 0.3\%$, and with generally $<$ five iterations per time-step. A discretization analysis revealed that for the first centimeter below the soil surface a 0.2-cm nodal spacing was required to obtain accurate estimates of the evaporative flux and the near-surface water content profile. Below that depth, however, nodal spacing can be greatly increased without serious reduction of accuracy. Successful validation of the model supports extension to field conditions. (Author's abstract)
W85-02866

SCALING SOIL WATER PROPERTIES AND INFILTRATION MODELING,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, J. W. Naney, and D. R. Nielsen.
Soil Science Society of America Journal, Vol. 48, No. 5, p 970-973, September/October 1984. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Scaling factors, *Soil water, *Infiltration, Permeability coefficient, Wetting-front pressure head, Model studies.

We examined variability and interrelation of the scaling factors for Green-Ampt infiltration parameters of saturated hydraulic conductivity (K sub s) and wetting-front pressure head (h sub f) in a 9.6-ha grassland watershed, containing three hydrologically similar silt loam Mollisols. Scaling factors for different depths at a given site appeared to be related. The scaled mean K sub s decreased with depth, while the scale mean h sub f showed no trend. The K sub s scaling factors had greater variability between sites than the h sub f factors, and the relationship between the two sets of factors deviated appreciably from a 1:1 line. However, there was a linear relationship between them, which was utilized in modeling infiltration. The composite infiltration for the watershed calculated by using different, but related, scaling factors for K sub s and h sub f was very close to that obtained by using the same scaling factors, derived from either K sub s or h sub f for both. However, the distribution and range of the predicted infiltrations were greatly different. (Author's abstract)
W85-02867

INFILTRATION RATE OF SLOT MULCHES: MEASUREMENT AND NUMERICAL SIMULATION,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
G. J. Redinger, G. S. Campbell, K. E. Saxton, and R. I. Papendick.
Soil Science Society of America Journal, Vol. 48, No. 5, p 982-986, September/October 1984. 6 Fig, 14 Ref.

Descriptors: *Infiltration rate, *Slot mulches, *Numerical analysis, Mathematical studies, Mulching, Surface runoff, Erosion control, Permeability coefficient, Saturated flow.

Mulched soil slots may be used to increase infiltration and reduce runoff and erosion on land where infiltration is restricted by soil freezing or low soil permeability. To establish optimum slot dimensions and spacing, the effect of slot width, slot depth, and saturated hydraulic conductivity on infiltration must be determined. A numerical solution to the soil water flow equation in two dimensions was used to simulate slot mulch infiltration. The Kirchhoff integral transform was used to reduce the nonlinearity of the coefficients, and the finite difference equations were solved using a Newton-

Raphson procedure. Simulations were in reasonable agreement with field measurements. A sensitivity analysis was used to show the effect of simulated changes in saturated condutivity, slot dimensions, and slope on water infiltration into the slots. The effect of slope on infiltration was negligible. A function was derived which predicts steady infiltration rate, given values for saturated conductivity, slot depth, and slot width. (Author's abstract)
W85-02868

**EVALUATION OF SOME NEW TRACERS FOR SOIL WATER STUDIES,**
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. S. Bowman.
Soil Science Society of America Journal, Vol. 48, No. 5, p 987-993, September/October 1984. 10 Fig, 2 Tab, 30 Ref.

Descriptors: *Soil water, *Tracers, *Solute transport, Iodide, Thiocyanate, Fluorobenzoates, Bromide, Fluorinated hydrocarbons, High performance liquid chromatography, Chromatography.

Six anions which showed potential as tracers of soil water movement were evaluated in laboratory and field experiments. The anions included iodide (I(-)), thiocyanate (SCN(-)), and four fluorobenzoates: m-(trifluoromethyl)benzoic acid (m-TFMBA), o-(trifluoromethyl)benzoic acid (o-TFMBA), pentafluorobenzoic acid (PFBA) and 2,6-difluorobenzoic acid (2,6-DFBA). The sorption and mobility characteristics of the six potential tracers were compared to those of bromide (Br(-)), which served as an index tracer in all experiments. Initial tracer concentrations ranged from 20 to 100 mg/L. The anions were quantified simultaneously in sub-mL samples of soil solution using a high performance liquid chromatography technique. Batch equilibrations (28 d), and breakthrough curves (7 to 10 d) in a 2.5-m column of loamy sand, under both ponded and trickle-irrigated conditions, indicated that all the tracers except SCN(-) were conservative and were not sorbed. SCN(-) was not retarded in the column studies but did show a negative mass balance, most likely due to chemical and/or biological transformation. Distribution of a tracer solution applied to a field soil was monitored for 69 d in soil water from suction samplers (1.0- and 1.8-m depth) and in extracts from core samples. SCN(-), I(-), and m-TFMBA showed reduced concentrations relative to Br- at all sampling times and depths; o-TFMBA, PFBA, and 2,6-DFBA had distributions similar to that of Br(-). These latter three fluorobenzoates show promise as laboratory and field tracers of soil water, particularly where multiple tracing tests or totally exotic tracers are required. (Author's abstract)
W85-02869

**PREDICTOR-CORRECTOR METHOD FOR MEASUREMENT OF HYDRAULIC CONDUCTIVITY AND MEMBRANE CONDUCTANCE,**
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
Y. Mualem, and A. Klute.
Soil Science Society of American Journal, Vol. 48, No. 5, p 993-1000, September/October 1984. 12 Fig, 2 Tab, 5 Ref. NSF project ENG7-800845.

Descriptors: *Permeability coefficient, *Membrane conductance, *Soil water, *Capillary head, Hysteresis, Unsaturated flow, Flow cells, Hydraulic properties.

The hydraulic conductivity, K, of unsaturated soil as a function of water content, Theta, or capillary pressure head, Psi, is of fundamental importance in the analysis and prediction of water flow in unsaturated soils. The K(Psi) relationship is strongly hysteretic; the K(Theta) relationship is much less so. Variability in results on the hysteresis of K(Theta) may be due to lack of control of the flow conditions in the measurement of the conductivity, so that the hysteresis was involved in an unknown manner. A procedure was developed for measurement of the hydraulic conductivity of unsaturated soil on wetting and drying processes taking into account the hysteresis phenomenon. The method expedites the measurement of the hydraulic properties, minimizes experimental errors, and avoids ambiguity due to hysteresis. As the soil was rewetted and its conductivity increased, the membrane conductances also increased. This suggests that the conductances are dependent on the water content of the soil. The membrane conductance decreases by several orders of magnitude as the soil dries, and increases following a wetting process. The decrease in conductance did not seem to be caused by blockage of the membrane by suspended matter. A power function seems to represent quite well the relationship between the membrane relative conductance and the soil relative hydraulic conductivity. (Collier-IVI)
W85-02870

**SOIL COHESION AS AFFECTED BY TIME AND WATER CONTENT,**
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
W. D. Kemper, and R. C. Rosenau.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1001-1006, September/October 1984. 8 Fig, 8 Ref.

Descriptors: *Cohesion, *Soil water, *Water content, *Bonding, Soil physics, Soil structure, Cohesive soils.

Cohesion increased for several months after disruption in moist soils. Rate at which cohesion increased was slower in airdry soil, but continued for years. Moduli of rupture of soils also increased with time. Effects of water content on the rate at which cohesion increases are compatible with an explanation of the bonding mechanism in terms of slightly soluble components diffusing to and cementing points of contact between particles. Cohesional forces due to water are estimated and found to be large enough to provide a major portion of the cohesion measured in soils. These estimates are supported by decreased cohesion of a silty soil when dried. However, cohesion of soils with larger amounts of clay generally increases when they are dried, indicating that other bonding mechanisms predominate. (Author's abstract)
W85-02871

**CALCULATION OF INTERNODAL CONDUCTANCES FOR UNSATURATED FLOW SIMULATIONS: A COMPARISON,**
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
R. R. Schnabel, and E. B. Richie.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1006-1010, September/October 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Unsaturated flow, *Soil water, *Internodal conductance, Richards equation, Infiltration, Conductance, Conductivity.

Five techniques for calculating internodal conductance were compared during a finite-difference solution of the Richards equation. Arithmetic, geometric, and harmonic means as well as integrated and upstream weighted conductances were used to calculate steady-state water content distributions and infiltration into three soils. The water content distributions simulated using the integrated conductance resulted in distributions equivalent to those calculated analytically. Simulation results of infiltration most closely matched literature data when the integrated or geometric mean conductances were used. The harmonic mean conductance gave unacceptable results for all situations simulated. (Author's abstract)
W85-02872

**FLUORITE PRECIPITATION IN A CALCAREOUS SOIL IRRIGATED WITH HIGH FLUORIDE WATER,**
Colorado State Univ., Fort Collins.
P. W. Tracy, C. W. Robbins, and G. C. Lewis.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1013-1016, September/October 1984. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Fluorites, *Fluorides, *Calcareous soils, *Irrigation water, *Chemical precipitation, Lysimeters, Alfalfa, Idaho, Water pollution sources, Groundwater pollution.

Lysimeters filled with Freedom silt loam soil (fine-silty, mixed, mesic, Xerollic Calciorthids) were irrigated with geothermal well water from south central Idaho. The water contained 7 mg F/L. Alfalfa (Medicago sativa L.) was grown in the lysimeters and the water was applied at a rate to give either a 0.30 or 0.15 leaching fraction. After irrigating the 1.0 m deep soil samples for 600 d, over 98% of the added F remained in the soil. Soil extract and lysimeter leachate analysis showed that fluorite precipitation was occurring in the upper profile, but only after another fluoride adsorption mechanism was saturated and the fluoride and calcium ion activities exceeded the CaF2 ion activity product. The F concentration in the upper profile extracts exceeded 20 mg F/L and with the additional high F water irrigation, the soluble F would be expected to leach deeper in the soil. Under field conditions the F would be expected to eventually move into the groundwater with continued irrigation with high F water. (Author's abstract)
W85-02873

**STORED AVAILABLE SOIL WATER AND THE FALLOW/RECROP DECISION-CRITICAL LEVEL APPROACH,**
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2I.
W85-02874

**SCANNING ELECTRON MICROSCOPE STUDIES OF SURFACE CRUSTS FORMED BY SIMULATED RAINFALL,**
California Univ., Davis. Dept. of Land, Air and Water Resources.
O. Onofiok, and M. J. Singer.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1137-1143, September/October 1984. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Soil physical properties, *Scanning electron microscopy, *Rainfall penetration, *Soil surfaces, Soil porosity, Pore size, Crusts.

The micromorphology of the surface layer of three California soils, Columbia fine sandy loam, Wyo clay loam, and Yolo silt loam, undergoing crust formation by simulated rainfall was studied using the scanning electron microscope (SEM). Crusts formed at the time of ponding (early crust) and after 60 min rainfall were examined. At the early crust stage, crusts on all soils comprised a very thin compact surficial layer, about 0.05 mm thick, and a more open underlying layer of uniform pore and particle size distributions comparable to those of the undisturbed soil. At a later stage, the crusts on Yolo and Wyo soils consisted of an upper layer (about 0.1 mm thick) of high porosity, composed predominantly of individual sand grains and a lower layer of considerably reduced porosity, composed of a higher concentration of clay and silt sized particles. The lower layer, called the 'washed-in' zone, results from the accumulation of fine materials washed out in the upper layer. Columbia later crust also comprised an upper compact surface layer (about 0.05 mm thick) of well oriented platy particles, and a lower more open layer with particles uniformly reduced in size. Decreased apparent porosity at 0.3- to 0.8-mm depth, measured directly on the SEM photomontages, indicated the presence of the 'washed-in' zone in the Yolo and Wyo late crusts and its absence in the Columbia. Mean pore size of the later crust Yolo sample was significantly reduced compared to the no-crust treatment. Small changes in mean pore size were also observed for the other two soils. (Author's abstract)
W85-02875

**ALFALFA GROWTH AND SOIL OXYGEN DIFFUSION AS INFLUENCED BY DEPTH TO WATER TABLE,**

Agricultural Research Service, Orono, ME. New England Plant, Soil and Water Lab.
J. Bornstein, G. R. Benoit, F. R. Scott, P. R. Hepler, and W. E. Hedstrom.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1165-1169, September/October 1984. 7 Fig, 4 Tab, 17 Ref.

Descriptors: *Alfalfa, *Oxygen diffusion, *Soil properties, *Water table, *Crop growth, Crop yield, Soil water, Drainage.

Growth and yield of alfalfa and oxygen diffusion rate (ODR) as influenced by excess water were investigated via three depth to water table (WT) treatments, through two different falling water table sequences. The environment for the study was a simulated profile of a Munson silty clay loam, mesic frigid Aeric Haplaquepts, placed in 12 large cylinders 0.61-m diam by 1.52 m deep each seeded to Iroquois alfalfa (Medicago sativa L.). Each sequence was run through three consecutive 42-d growth cycles. The first sequence was one flooding-recession per growth cycle while the second sequence included three floodings at two-week intervals during each cycle. Each cycle began immediately after previous crop harvest, with 3-d saturation followed by lowering the WT to fixed 0.15-, 0.45-, and 0.75- m depths, respectively. ODR values at a 0.075-m depth averaged over three growth cycles from the single falling water table treatment showed little change during the saturation to drawdown period for the 0.15-m WT but highly significant variation for the 0.45- and 0.75-m WT treatments. Growth rates for all treatments followed a pattern of two weeks of rapid growth followed by a declining growth rate to harvest. For the sequence having three flooding-drawdowns per cycle, crop growth and yield increased significantly as a linear function of WT depth from 0.15 to 0.75 m. The soil water system showed a 3- to 4-d drawdown after each flooding with WT drawdown having a positive effect to a 0.75-m depth. (Author's abstract)
W85-02877

**WEIGHING LYSIMETERS FOR LONG-TERM WATER BALANCE INVESTIGATIONS AT REMOTE SITES,**
Battelle Pacific Northwest Labs., Richland, WA.
R. R. Kirkham, G. W. Gee, and T. L. Jones.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1203-1205, September/October 1984. 4 Fig, 7 Ref.

Descriptors: *Lysimeters, *Water balance, *Soil water, Evaporation, Evapotranspiration, Drainage, Hanford, Washington, Automation.

Two weighing lysimeters were installed at a remote location on the Department of Energy's Hanford Site in Washington State in 1978 and 1979. Platform-type electronic scales were placed below the soil surface to measure the weight changes of a large (approximately 7 Mg) container of soil. The load cells of the scales have been exposed to high humidity and to periodic contact with drainage water, but have operated without failure since installation (over 5 years). Weight changes are continuously recorded, with hourly averages transmitted by phone line directly to the laboratory. The sensitivity of the scale is 50 g, equivalent to 0.02 mm of H2O. (Author's abstract)
W85-02879

**DISTRIBUTION OF DEUTERIUM AND 18O IN DRY SOILS; 3. THEORY FOR NON-ISOTHERMAL WATER MOVEMENT,**
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
C. J. Barnes, and G. B. Allison.
Journal of Hydrology, Vol. 74, No. 1/2, p 119-135, October, 1984. 1 Fig, 24 Ref.

Descriptors: *Soil water, *Evaporation, *Deuterium, *Oxygen isotopes, Diffusion, Convection, Soil temperature.

A model is developed which predicts the shape of H2O-18 and HDO depth profiles which result from evaporation of water from a soil under non-isothermal and quasi-steady-state conditions. The profiles have similar form to those which develop under isothermal conditions. When the soil at depth is cooler than the soil surface - the condition under which most evaporation takes place - a minimum develops in the isotope profile some distance beneath the evaporating front. This is due to the diffusive flux of isotopes in the vapor phase partially offsetting the convective isotope flux in the liquid phase. For coarse-textured soils under isothermal conditions the diffusive vapor flux of isotopes may be the dominant mechanism in balancing convective effects in the liquid phase, even when no net movement of water vapor occurs. The theory is extended to enable partitioning of the water flux into liquid and vapor components under both isothermal and non-isothermal conditions. (Author's abstract)
W85-03086

**INFILTRATION MEASUREMENTS IN A SMALL LOWLAND CATCHMENT,**
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
For primary bibliographic entry see Field 2E.
W85-03090

**EFFECTS OF MAGNETIC PARTICLES ON THE UNFROZEN WATER CONTENT OF FROZEN SOILS DETERMINED BY NUCLEAR MAGNETIC RESONANCE,**
Cold Regions Research and Engineering Lab., Hanover, NH.
A. R. Tice, and J. L. Oliphant.
Soil Science, Vol. 138, No. 1, p 63-73, July, 1984. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil water, *Nuclear magnetic resonance, *Frozen soils, *Magnetic particles, Magnetite, Ferromagnetic particles.

When small numbers of ferromagnitic particles exist in the soil matrix, the magnetic field is altered on a local level around the magnetic particles, and any liquid water protons in this altered magnetic field will not absorb RF energy at the same frequency as those in the unaltered field. Liquid water protons in the locally altered magnetic field do not contribute to the nuclear magnetic resonance (NMR) signal intensity. This causes a decrease in the NMR signal intensity when NMR is being used to measure unfrozen water contents in partially frozen soils or total water contents in thawed soils. Tuto clay, a soil containing no magnetic particles, was mixed with various small amounts of pure powdered magnetite, and the NMR signal intensity was determined while the samples were both thawed and partially frozen. An equation that correlates the thawed sample signal intensity with the weight percent of powdered magnetite added was derived. The unfrozen water content of the partially frozen samples could be determined accurately for samples containing up to 0.2 to 0.3% magnetite. Several methods for demagnetizing soils containing large amounts of magnetic particles were tried, with the most effective found to be stirring a slurry of the soil over a powerful permanent magnet. Accurate unfrozen water contents could be determined for all the partially frozen samples if some form of demagnetizing procedure was used on those samples containing the most magnetic particles. Exactly what the relationship is between soils containing natural magnetic particles and those containing pure magnetite is still uncertain. (Moore-IVI)
W85-03093

**WATER AND AIR MOVEMENT IN SOILS: AN APPLICATION OF BRUTSAERT'S AND OPTIMIZATION TECHNIQUES,**
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
G. Sander, and J.-Y. Parlange.
Soil Science, Vol. 138, No. 3, p 198-202, September, 1984. 1 Fig, 18 Ref.

Descriptors: *Soil water, *Infiltration, *Air effects, *Brutsaert's technique, Optimization, Diffusivity, Soil water potential, Water pressure.

The process of infiltration into a soil profile is one of simultaneous flow of two phases, air and water. For infiltration into an unbounded soil profile, the generally accepted assumption that Richard's equation describes the infiltration process is not strictly correct. An accurate analytical approximation for the water profile in a soil is presented which takes into account small but nonnegligible air effects. The method relies on using a Brutsaert-type profile and an optimization condition. The approximation is accurate enough for any practical purpose, but an iterative scheme can also be used if more accuracy is needed. Precision of the method for an exponential law diffusivity is assessed, and a simpler but still accurate approximation is presented. Water intake for constant soil water potential at the surface increases with air effects, but it decreases for constant water pressure, as expected. (Moore-IVI)
W85-03094

**CALIBRATION OF SOIL SURFACE NEUTRON MOISTURE METER,**
S. M. Farah, R. J. Reginato, and F. S. Nakayama.
Soil Science, Vol. 138, No. 3, p 235-239, September, 1984. 5 Tab, 18 Ref.

Descriptors: *Soil moisture meters, *Neutron probes, Soil water, Irrigation, Water management, Calibration.

Accurate information on the soil water content of both the surface and deeper layers is indispensable for reliable water management in crop production. Two types of lightweight neutron surface moisture probes built for testing leaks in roofs were adapted to measure surface soil water content. The introduction of dual detector tubes is one of the primary differences from the older surface moisture probes. The probes were calibrated as a function of soil water content under field conditions with an Avondale loam soil. Calibration curves were obtained for both probes to a depth increment of 30 cm. There is no unique pattern in the data to indicate the superiority of one meter over the other to determine the soil water content for all depth increments. The probes can be used to monitor surface soil water content and its changes, and they complement the depth probes whose accuracy fails at depths shallower than 20 cm. The surface neutron meter could be applied where shallow-rooted crops were being irrigated frequently. (Moore-IVI)
W85-03096

## 2H. Lakes

**OXYGEN DEMAND AND LONG TERM CHANGES OF PROFUNDAL ZOOBENTHOS,**
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5C.
W85-02770

**EUTROPHICATION OF LAKES LEMAN AND NEUCHATEL (SWITZERLAND) INDICATED BY OLIGOCHAETE COMMUNITIES,**
Conservation de la Faune, Saint-Sulpice (Switzerland).
C. Lang.
Hydrobiologia, Vol. 115, p 131-138, August, 1984. 4 Tab, 23 Ref.

Descriptors: *Lake Leman, *Lake Neuchatel, *Switzerland, *Eutrophic lakes, *Oligochaetes, Lakes, Annelids, Bioindicators, Population density, Species diversity.

In 1978-80, oligochaete communities of meso-eutrophic Lake Leman (Lake of Geneva) were compared to those of mesotrophic Lake Neuchatel. Worm species were classified into three groups corresponding to their increasing tolerance to eutrophication: (1) oligotrophic species, mostly Peloscolex velutinus, Stylodrilus heringianus; (2) mesotrophic species, mostly Potamothrix vejdovskyi, P. bedoti; (3) eutrophic species, mostly Potamothrix hammoniensis, P. heuscheri, Tubifex tubifex. In both lakes, eutrophic species constituted the bulk

of the communities in terms of absolute abundance. However, relative abundance of mesotrophic and eutrophic species was higher in Lake Leman; oligotrophic species were more important in Lake Neuchatel. These data confirmed the trophic classification of lakes based on chemical parameters. The number of zero values, which perturbated statistical analysis, was reduced by using species groupings instead of isolated species. Thus, making the lakes more comparable even if different species were present in each one. Relative density values based on all samples were distributed among 4 density classes for the 3 species groupings. The 12 resulting frequencies described the community structure expressed in terms of eutrophication. Furthermore, these frequencies may be used for comparison of eutrophication levels in several lakes. (Author's abstract)
W85-02772

**OLIGOCHAETA OF THE MIDDLE PO RIVER (ITALY): PRINCIPAL COMPONENT ANALYSIS OF THE BENTHIC DATA,**
Milan Univ. (Italy).
A. Paoletti, and B. Sambugar.
Hydrobiologia, Vol. 115, p 145-152, August, 1984. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Middle Po River, *Italy, *Oligochaetes, *Principle component analysis, *Benthos, Aquatic habitats, Macrophytes, Sediments, Water temperature, Dissolved oxygen, Seasonal variation.

The application of principal component analysis to two types of habitat (the benthos of macrophytes and of central river bed) enabled us to single out some of the factors that affect the dynamics and the structure of the oligochaete population and its various reactions to environmental conditions. As regards macrophytes, the distribution of the variables on the basis of the first component is correlated, to a certain extent, with a seasonal factor without any significant differences among sites. The largest population is most closely correlated with the summer months. In fact, we found that the Naididae and Tubificidae species generally develop in larger numbers at higher temperatures. For the Tubificidae, we could detect a precise seasonal cycle. In the central river bed habitat, the first component was correlated with the river discharge, which determines the granulometric characteristics of the sediment; we noticed a correlation among the sites that have the same characteristics, regardless of sampling site or date. The species which correlate most closely among themselves are the Tubificidae Limnodrilus hoffmeisteri, Tubifex tubifex, L. udekemianus and L. profundicola, which are very characteristic of environments that contain abundant organic matter. The second component is correlated with temperature, and hence with the availability of oxygen, which determines the presence and the abundance of more sensitive species. (Author's abstract)
W85-02774

**COMPARISON OF DIFFERENT METHODS OF WATER QUALITY EVALUATION BY MEANS OF OLIGOCHAETES,**
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
For primary bibliographic entry see Field 5C.
W85-02775

**RESPONSES OF PHYTOPLANKTON TO EXPERIMENTAL NUTRIENT ENRICHMENT IN AN AMAZON FLOODPLAIN LAKE,**
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W85-02785

**CARBON AND HYDROGEN ISOTOPIC COMPOSITION OF BACTERIAL METHANE IN A SHALLOW FRESHWATER LAKE,**
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
I. Woltemate, M. J. Whiticar, and M. Schoell.
Limnology and Oceanography, Vol. 29, No. 5, p 985-992, September, 1984. 5 Fig, 1 Tab, 35 Ref.

Descriptors: *Lake sediments, *Methanogenesis, *Hydrogen, *Carbon, *Bacteria, Methane, Lakes.

Anoxic sediments from freshwater environments such as bogs, swamps, and lakes undergoing early diagenesis are frequently characterized by the formation of biogenic methane. Freshwater biogenic methanes exhibit carbon and hydrogen isotopic values strongly depleted in C-13 and deuterium relative to the respective values for carbon dioxide and formation water. The percentages of methane generated by fermentation and carbon dioxide reduction can be estimated by comparison of hydrogen isotopes in the formation water and methane. On the basis of these hydrogen isotope data, about 75% of the methane formation in Wurmsee comes from acetate reduction. Fermentation is thus the dominant although not exclusive process. Carbon dioxide reduction contributed the balance of the bacterial methane generated. (Baker-IVI)
W85-02786

**DISSOLVED IODINE SPECIES IN A BRITISH FRESHWATER SYSTEM,**
Institute of Hydrology, Wallingford (England).
S. D. Jones, and V. W. Truesdale.
Limnology and Oceanograhpy, Vol. 29, No. 5, p 1016-1024, September, 1984. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Lakes, *Iodine, *Speciation, *England, *Esthwaite Water, Oxidation, Reduction, Iodate, Iodide.

A 16 month study was conducted of the behavior of dissolved iodine species in a freshwater system in the English Lake District. Iodate and iodide were the principal forms of dissolved iodine in this freshwater system. If the system were in thermodynamic equilibrium, iodate would be the only form detectable. The net reduction of iodate either during the sea-to-air exchange of iodine or during transport in the atmosphere is probably responsible. Once deposited in rain, net oxidation of iodide occurs, the measured speciation approaching that at equilibrium as the iodine moves around this hydrological cycle. Small perturbations in this trend occur within the lakes, where seasonally dependent redox processes operate. Over an annual cycle these processes nullify one another, thereby maintaining the progression toward equlibrium. In the anoxic hypolimnion of Esthwaite Water regeneration processes operated when anoxic conditions develop and iodide is released into solution, presumably by bacterial decomposition of iodine incorporated into organic matter. The particulate iodine could be formed in either the aquatic or terrstrial environment. The behavior of iodine in these freshwater lakes is consistent with that in oxic and anoxic marine basins. Interconversion is not as pronounced as would be expected purely by comparing lacustrine and marine productivities and iodine concentrations. The smaller interconversion in the freshwater environment probably results from the short residence time of the lake waters. Water residence times in marine systems are several orders of magnitude greater. (Baker-IVI)
W85-02788

**ENVIRONMENTAL FACTORS AND AQUATIC MACROPHYTE RESPONSE IN REGULATED LAKES - A STATISTICAL APPROACH,**
Norsk Inst. for Vannforskning, Oslo.
B. Rorslett.
Aquatic Botany, Vol. 19, No. 3-4, p 199-220, September, 1984. 12 Fig, 2 Tab, 12 Ref. Norwegian Inst. for Water Research grant OF-81620.

Descriptors: *Statistical analysis, *Macrophytes, *Water level, *Norway, *Lakes, Fluctuation, Vegetation, Water depth, Aquatic plants, Ice scour, Solar radiation.

The statistical approach is discussed with vegetation and water level data from nine selected Norwegian lakes. The concepts of depth and relative elevation need to be carefully distinguished. This is essential when a regulated lake with appreciable fluctuation of water level is considered. Even by relating the vertical position of a plant site to the median water level as datum, site depth in its time-averaged sense is not equivalent to the relative elevation of this point. Further, the magnitude discrepancies, in general, are large in shallow waters where many species attain their peak performance. Recasting the vertical distribution of suberged macrophytes in terms of the time averaged depth resolves ambiguity. Between-lake comparisons of depth distributions are then facilitated. Environmental stress factors such as ice-scour, influence aquatics over a much larger part of the depth gradient with a variable water level. Factors operating through threshold statistics such as subsurface irradiance, are most adversely influenced by a time-varying water level. Regulation impact generally results in a compressed vertical niche. Simultaneously, the potential niche is shifted into deeper waters. Vegetation data from nine oligotrophic, regulated Norwegian lakes show significant correlation to the reduced vertical niche defined by ice-scour and threshold irradiance. Water-level schedules determine the actual vegetational response. Thus the total probability distribution of water levels should replace the regulation height or mean annual range of water level variation in an analysis of response features. (Baker-IVI)
W85-02793

**PHOTOSYNTHESIS OF SUBMERSED MACROPHYTES IN ACIDIFIED LAKES. I. CARBON FLUXES AND RECYCLING OF CO2 IN JUNCUS BULBOSUS L.,**
Uppsala Univ. (Sweden). Limnologiska Institutionen.
R. G. Wetzel, E. S. Brammer, and C. Forsberg.
Aquatic Botany, Vol. 19, No. 3-4, p 329-342, September, 1984. 8 Fig, 35 Ref.

Descriptors: *Carbon dioxide, *Fluctuations, *Angiosperms, *Macrophytes, *Photosynthesis, *Acidity, *Lakes, Recycling, Acid rain, Ecosystems.

Photosynthetic characteristics of carbon dioxide fluxes and light responses in the submersed angiosperm Juncus bulbosus L. were analyzed in a Cartesian-diver system in which irradiance could be stringently controlled. Results indicate that much of the CO2 fixed photosynthetically emanated from recycling of photorespired CO2 and from respiration within the rooting tissue and bacterially in the rhizosphere. The exchange of inorganic carbon, primarily CO2 at the pH of acidified ecosystems, between water and submersed macrophytes is slow in comparison to terrestrial plants, both because of high resistance of CO2 diffusion in water and to diffusion within the tissue of submersed leaves. The restricted availability of dissolved CO2 in acidified fresh waters imposes severe limitations upon macrophytes for active photosynthesis. The gas lacunal system was critical for appreciable net carbon fixation. Over 50% of the carbon dioxide fixed under the experimental conditions was recycled from respiratory sources. A portion of the assimilated CO2 of active photosynthesis passes through the glycolate pathway. Diffusion of this CO2 out of the leaves to the water is slow, particularly under radiant conditions of high photosynthetic demand. This causes the CO2 to be efficiently recycled. Some of the CO2 diffuses into the lacunal spaces in immediate juxtaposition to the cells or is refixed intracellularly. Removal of the gas phase by internal lacunal flooding greatly altered this recycling pattern, and allowed little net fixation. (Baker-IVI)
W85-02794

**CHEMICAL LIMNOLOGY OF LAKE ARROZ (CAREIRO ISLAND), RESULTING FROM WATER LEVEL FLUCTUATIONS IN THE CENTRAL AMAZON RIVER (LIMNOLOGIA QUIMICA DO LAGO DO ARROZ (ILHA DO CAREIRO), SUAS FLUTUACOES EM FUNCAO DO MEIO HIDRICO DO RIO AMAZONAS),**
Amazonas Univ., Manaus (Brazil).
U. B. Lopes, U. de Menezes Santos, and M. de Nazare Goes Ribeiro.
Acta Amazonica, Vol. 13, No. 2, p 227-253, April, 1983. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Lake Arroz, *Careiro Island, *Limnology, *River Solimoes, *Water level fluctua-

tions, Chemical composition, Stratification, Stagnation, Acari-Bodo, Ecological effects, Cycling nutrients.

The limnological conditions of the Arroz Lake, Careiro Island, central Amazon, are determined by the River Solimoes, since they are linked almost all year round. The water level varies annually between 7 and 9 meters with peak levels in June and lowest levels in January. This cycle is the principle factor determining the great physical chemical and biological variations which occur in the lake. The chemical analysis clearly demonstrate the seasonal variations in the Arroz Lake: stagnation, with a clear separation between the epilimnion and the hypolimnion, temperature stratification, total salt content and the presence of complex notable agents during the high water and the total moisture during lowest level water. From September onwards the lake receives an intense migration of fish of the Loricariidae family, more commonly known as 'acari-bodo' (65,000 of these fish were captured by six fishermen between September to December). These fish provoke an intense resuspension of green sediments in the lake, since in laying their eggs they dig holes up to twenty centimeters deep in the mud. That recirculation jointly with the effect of the wind causes the resuspension of the sediments, increasing the quantity of dissolved mineral salts. This phenomenon causes several anomalies which permit an elevated degree of recycling of nutrients, and primary production, which practically determines the absence of stratification of the sediments. (Author's abstract)
W85-02815

**SALINITY STRESSES ALONG A COMPLEX RIVER CONTINUUM: EFFECTS ON MAYFLY (EPHEMEROPTERA) DISTRIBUTIONS,**
Oklahoma Univ., Norman. Dept. of Zoology.
W. P. Magdych.
Ecology, Vol. 65, No. 5, p 1662-1672, October, 1984. 9 Fig, 3 Tab, 35 Ref. NSF grant DEB-8112460.

Descriptors: *Rivers, *Washita River, *Oklahoma, *Mayflies, *Salinity, River Continuum Concept, ALSCAL, Benthos, Population dynamics, Stress, Model studies.

The problems encountered in attempting to compare physical, chemical, and biological parameters are considered with the ALSCAL model of multidimensional scaling. The River Continuum Concept (RCC) was used to evaluate physical, chemical and biological variables in the saline-stressed Washita River in western Oklahoma found over 14 sampling intervals. Physical parameters represented stream discharge, sediment particle sizes, organic content of the sediment, and related factors. Chemical variables included conductance, pH, and concentrations of major salts. Biological variables were densities of mayfly genera from dredge samples. The ordinations produced by ALSCAL summarized the relationships among sites over sampling time. These nonmetric ordinations were based on distance coefficients which greatly reduced many of the problems associated with comparing different types of variables. Rankings of sites along the dimensions of the respective ordinations represented the underlying physical, chemical, and biological structure of the river. This allowed the comparison of abstract structures based on these three groups of variables to the structure of the actual river gradient. Congruence in the rankings of sites for each group of variables suggested a close relationship among the associate variables in congruence. The saline effects are not predicted by the RCC. These saline effects are orthogonal, abstract gradients controlled by complex geomorphological processes. These results still fit into the general framework of the RCC in that the benthic community structure appears to be a function of abiotic parameters. But multiple gradients must be considered when developing dynamic management models for similar systems. (Baker-IVI)
W85-02819

**UNDERSTANDING SIMPLIFIED LAKE ACIDIFICATION MODELS,**
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-02822

**SPATIAL VARIATIONS IN THE WATER QUALITY OF LOUGH ERNE, NORTHERN IRELAND, ON THE BASIS OF SURFACE SEDIMENT DIATOM ANALYSIS,**
University Coll., London (England).
R. W. Battarbee.
Freshwater Biology, Vol. 14, No. 5, p 539-545, October, 1984. 4 Fig, 13 Ref.

Descriptors: *Lough Erne, *River Erne, *Donegal Bay, *Water quality, *Spatial variation, *Northern Ireland, *Lakes, Sediments, Diatoms.

The Lough Erne system comprises two main lakes, Upper and Lower Lough Erne. The lakes are connected by the River Erne and this river forms the outlet to the system at Belleek and ultimately discharges into Donegal Bay. Both lakes are morphometrically complex with many sub-basins and islands. Maximum depth of Lower Lough is 69 m and of the Upper Lough is 27 m. The lake system is eutrophic, increasingly so over the last 100 yr. During the study four more or less distinct groups of surface diatom assemblages were found within the Lough Erne basin. Zone I is a region of variable conditions probably strongly influenced by inflowing rivers. Zones II, III and IV describe major areas of the two lakes within each of which limnological conditions are likely to be relatively uniform. The main division does not occur between the two lakes but between Zones III and IV on Lower Lough Erne where the more shallow, highly productive, islanded zone of the upper reaches gives way via an extensive transitional area to the deep open water and less productive zone of the main basin. The division between Zones II and II occurs some 3 miles beyond the point at which the River Erne flows into the Lower Lough, indicating the substantial influence of the river water from the Upper Lough on the initial reaches of the Lower Lough. Three main sampling sites are probably adequate to reflect conditions in the lake system. Such sites should be located in the lower part of Upper Lough Erne, the upper part of Lower Lough Erne, but at least 3 miles from the river inflow, and in the open water zone of the Lower Lough beyond the transition zone. Surface sediment diatom assemblages can be used to assess regional differences in complex lake systems, especially if the data are standardized by excluding peripheral phyton from the percentage totals. These sediment surveys can aid in the choice of routine monitoring sites and the location of sediment core sites. (Baker-IVI)
W85-02843

**BIOLOGICAL PRODUCTIVITY OF LAKE QARUN (ARAB REPUBLIC OF EGYPT),**
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
S. A. Abdel-Malek.
Journal of Ichthyology, Vol. 21, No. 6, p 22-32, 1981. 12 Tab, 42 Ref. Translated from Voprossy Ikhtiologii, Vol. 21, No. 6, 1981.

Descriptors: *Lake Qarun, *Egypt, *Fish, Population dynamics, *Salinity, Fisheries, Fish management, Phytoplankton, Zooplankton, Drainage water, Mollusks, Eutrophication.

Change in the composition of the ichthyofauna and food base of Lake Qarun was studied in relation to its salinization due to mineralized drainage water. The possibility of supplementing the ichthyofauna with some marine species has been investigated. Lake Qarun is rich in nitrates and organic nitrogen, from drainage from the fields. Nitrite and phosphate contents are very low. The entry of the enriched drainage waters into the lake caused significant increases in salinity which in turn brought about great changes in the invertebrate fauna, the fresh water species being replaced by marine organisms. Species like Tilapia nilotica, Clarias lazera, Lates niloticus, Labeo niloticus, and Barbus bynni were eliminated. Supplementation of the ichthyofauna of the lake with marine species has been found to be effective and in 1976-77 about 67% of the total catch of 1200 tons consisted of mullet and sole. The shallow depths, large quantity of nutrients flowing into the lake with drainage water from the irrigated land, and high water temperature throughout the year ensure high biological productivity of the lake. On the basis of phytoplankton development, Lake Qarun is eutrophic. The average biomass of benthos in the lake is 3 times higher than the biomass of the bottom fauna in the Azov sea which is highly productive. The high production of mollusks in Lake Qarun and their poor utilization by the fishes suggests the possibility of acclimatization of mollusk-eating fishes in this reservoir. (Baker-IVI)
W85-02851

**INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE POPULATION DYNAMICS OF SMELT, OSMERUS EPERLANUS (OSMERIDAE),**
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
M. N. Ivanova.
Journal of Ichthyology, Vol. 22, No. 5, p 172-175, 1982. 1 Fig, 2 Tab, 15 Ref. Translated from Voprosy Ikhtiologii, Vol. 22, No. 6, p 45-51, 1982.

Descriptors: *Smelt, *Lake Beloye, *Rybinsk Reservoir, *USSR, *Fish populations, *Population dynamics, Physicochemical properties, Water temperature, Growth stages, Oligotrophic lakes.

Environmental factors acting on different developmental stages were delineated to determine the life span of smelt, Osmerus eperlanus, from individual year classes; environmental factors causing changes in population structure were also delineated. These were based on long-term observations on the biological features of fish from the Lake Beloye and Rybinsk Reservoir (USSR) populations, and also on experimental work on rearing the Ladoga smelt in ponds. The number of circuli on the scales formed in a given year were used as natural marks for determination of which specimens lived to the maximum age characteristic of each population. The temperature regime and the feeding capacity of the body of water during the period of larval development determine the rate of growth and the development of the reproductive system of the smelt and are factors in determining their population type. The conditions of winter feeding, and particularly the presence or absence of young fish which are accessible - as regards size - are also a factor determining the life span of the smelt and therefore also the structural peculiarities of their populations in different bodies of water. In cold, deep, oligotrophic bodies of water, the young smelt grows and develops slowly. Older specimens are practically always provided with fish food of suitable size. (Collier-IVI)
W85-02855

**CHEMISTRY, MINERALOGY, AND MORPHOLOGY OF LAKE ERIE SUSPENDED MATTER,**
National Water Research Inst., Burlington (Ontario).
A. Mudroch.
Journal of Great Lakes Research, Vol. 10, No. 3, p 286-298, 1984. 2 Fig, 8 Tab, 25 Ref.

Descriptors: *Lakes, *Mineralogy, *Chemical analysis, *Morphology, *Lake Erie, *Suspended sediments, Water analysis, Organic matter, Calcite, Decomposition.

Suspended matter was collected in Lake Erie in 1978 at the following localities and time: from 1-m, 6-m, and 13-m water depth at a station in the central basin in May, August and September; and from 1-m, 30-m, and 61-m water depth at the deepest point of the lake in May and September. Mineralogical and chemical composition of the samples suspended matter were investigated together with the morphology of individual particles. Al, Ti, and Mg were associated only with inorganic material. Si, Fe, Ca, K, Mn, and P were associated with both biological and inorganic material. The majority of the determined elements were

present in more than one chemical form. Inorganic material was composed mainly of mineral fragments and biological material included pieces of diatoms, other algal species, and amorphous particles and flocculates of unknown origin. The major components of the suspended matter in Lake Erie were organic material, aluminosilicates, and calcite. The high levels of organic material and fluctuations of calcite concentration in the suspended matter indicate a high rate of photosynthesis and respiration in the epilimnion during summer. The concentration of organic C in suspended matter exceeded many times that of the surface sediments, especially in August and September, indicating decomposition and transport of organic matter within the water column or at the sediment-water interface. (Baker-IVI)
W85-02890

**COMPOSITION OF PARTICULATE ORGANIC MATTER IN THE EUPHOTIC ZONE OF LAKE SUPERIOR,**
Canada Centre for Inland Waters, Burlington (Ontario).
E. Halfon.
Journal of Great Lakes Research, Vol. 10, No. 3, p 299-306, 1984. 2 Fig, 3 Tab, 40 Ref.

Descriptors: *Great Lakes, *Organic matter, *Water analysis, *Lake Erie, *Euphotic zone, Productivity, Seston, Detritus, Nutrients, Chlorophyll.

A regression method was used to derive the composition of particulate organic matter (POM) as living and dead material in the euphotic zone of Lake Superior, May to November 1973. A modification was made to the literature regression method as it had a conceptual bias and overestimated detritus. POM composition expressed as chlorophyll, particulate organic carbon, particulate organic nitrogen, and particulate organic phosphorus was also analyzed. This analysis showed living seston to be the major component of POM during the 7 months. Detritus was minimal during the year and increased to 39% of POM by fall. Most detritus was autochthonous. The lack of correlation between the particulate organic phosphorus and the other components of POM shows that the available phosphorus is rapidly recycled in an efficient manner and not significantly bound in detrital material. The coupling of statistical techniques and data collected during the intensive study of Lake Superior has provided a good insight into the interrelationships and seasonal patterns of nutrients and chlorophyll. (Baker-IVI)
W85-02891

**SEDIMENT TRAP STUDIES IN LAKE MICHIGAN: RESUSPENSION AND CHEMICAL FLUXES IN THE SOUTHERN BASIN,**
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2J.
W85-02892

**DISTRIBUTION OF EURASIAN WATERMILFOIL, MYRIOPHYLLUM SPICATUM, IN THE ST. CLAIR-DETROIT RIVER SYSTEM IN 1978,**
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. W. Schloesser, and B. A. Manny.
Journal of Great Lakes Research, Vol. 10, No. 3, p 322-326, 1984. 2 Fig, 29 Ref.

Descriptors: *Macrophytes, *St. Clair-Detroit River, *Lake Huron, *Lake Erie, *Great Lakes, *Watermilfoils, Boating, Recreation, Nuisance, Aquatic weeds.

Watermilfoils were relatively unnoticed in the US until the late 1950s when they became a nuisance in large water bodies. Submersed macrophytes were surveyed at 595 stations in the St. Clair-Detroit River system, 23 August to 13 October, 1978. M. spicatum was the fourth most common submersed macrophyte throughout the river system and the third or fourth most common submersed macrophyte in each of the four waters composing the system. The high occurrence of M. spicatum in the St. Clair River below Algonac suggests that it was introduced into the system near that city. Observations made during the study and interpretations of an aerial photograph suggest that M. spicatum was a minor nuisance to small boat navigation in portions of the system. (Baker-IVI)
W85-02893

**VARIATION OF CALCIUM, MAGNESIUM, SODIUM AND POTASSIUM CONCENTRATION, PH AND CONDUCTIVITY IN LAKES IN NORTHERN IRELAND,**
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey, and C. E. Gibson.
Archiv fur Hydrobiologie, Vol. 101, No. 3, p 345-360, September, 1984. 9 Fig, 4 Tab, 28 Ref.

Descriptors: *Lakes, *Ireland, *Calcium, *Magnesium, *Sodium, *Potassium, *Hydrogen ion concentration, *Conductivity, Precipitation, Rock dominance, Physicochemical properties.

The relative amounts of precipitation and rock dominance, as expressed by the Na/(Na + Ca) weight concentration ratio, was found to be an important influence on the chemical composition of lakes in Northern Ireland. Conductivity and pH decreased exponentially with the ratio. When expressed in percentage molar terms, calcium and magnesium decreased linearly with the ratio, sodium increased linearly and potassium remained constant. The results suggested that geological factors do not influence the major cation composition greatly. Only where the parent material composition deviates markedly from the lithosphere average, as with basalt and the magnesium concentration, does the cation composition deviate greatly from the general trends. (Author's abstract)
W85-02894

**DISTRIBUTION OF MACROPHYTES AND MICROPHYTES IN HARD WATER OF THE EDER RESERVOIR INFLUENTS (DIE VERBREITUNG VON MAKROPHYTEN UND MIKROPHYTEN IN HARTWASSER-ZUFLUSSEN DES EDERSTAUSEES),**
Giessen Univ. (Germany, F.R.). Edersee Ecological Research Station.
G. Fricke, and L. Steubing.
Archiv fur Hydrobiologie, Vol. 101, No. 3, p 361-372, September, 1984. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Eder Reservoir, *Hesse, *Germany (Federal Republic), *Bioindicators, *Macrophytes, *Algae, *Hardness, Calcium, Ammonium, Phosphates, Saprobicity, Nutrients, Brooks, Streams.

Comparative investigations have been carried out in 5 hard water brooks of the calcium rich Eder reservoir to prove the validity of using macrophytes and microphytes as indicators of water quality. There have been good correlations of the saprobicity evaluation by microphytes and macrophytes, especially in the oligosaprobic and betamesosaprobic reach. The abundance of macrophytes Berula erecta, Callitriche spec., Nasturtium microphyllum and Veronica anagallis-aquatica showed negative correlation to the ammonium concentration beginning with 0.5 mg/l. No effect could be observed of the phosphate concentrations on the macrophytes. (Author's abstract)
W85-02895

**NUTRITIVE QUALITY AND SIZE FRACTIONS OF NATURAL SESTON IN AN IMPOUNDED RIVER,**
Environmental and Chemical Sciences, Inc., Aiken, SC.
P. F. Kondratieff, and G. M. Simmons, Jr.
Archiv fur Hydrobiologie, Vol. 101, No. 3, p 401-412, September, 1984. 5 Fig, 2 Tab, 44 Ref.

Descriptors: *Dan River, *Virginia, *Seston, Proteins, Aquatic drift, Size class, Rivers, Particle size, Particulate matter.

Organic seston nutritive quality and size fractions were investigated in the 3rd-4th order Dan River in southwestern Virginia. The river is dammed, forming a 67-ha hypolimnetic release impoundment. Seston quality was estimated by measuring both particulate protein and ash-free dry-weight (AFDW) on unfractionated seston and seston of three size classes (105-1000 micro m - Large; 25-105 micro m - Fine; 45-25 micro m - Ultrafine). Seston concentrations decreased significantly ($p < .0001$) from a mean of 3.79 mg/l upstream of the impoundment to means ranging from 1.22 to 2.01 mg/l in an downstream. The ultrafine size class dominated the seston by weight at all stations on all dates samples. Mean particle sizes ranged from 2.98 micro m to 4.39 micro m. Stations in the river (both upstream and downstream) had proportionally more large particles (10-12% by weight) than reservoir stations (2-3% by weight). Reservoir seston had significantly higher total protein per unit weight than riverine seston ($p < .05$) and a vast majority of the protein was in the ultrafine fraction at all stations (95-99% of total protein per unit weight). The reservoir apparently exported higher quality seston than it received in this study, but 5 km downstream of the dam the quality and size class composition were similar to that at an upstream reference site. The major effect of this impoundment was to decrease the concentration of seston in the river downstream. (Author's abstract)
W85-02897

**NITROGEN FIXATION IN THE SEDIMENT OF SHALLOW LAKE BALATON, A RESERVOIR AND FISHPONDS,**
Fisheries Research Inst., Szarvas (Hungary).
J. Olah, M. A. B. Moneim, and L. Toth.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 1, p 13-44, 1983. 5 Fig, 19 Tab, 52 Ref.

Descriptors: *Lake Balaton, *Keszthely Basin, *Koros Reservoir, *Hungary, *Nitrogen fixation, *Lake sediments, Acetylene, Ethylene, Hydrogen ion concentration, Oxidation-reduction potential, Ammonia, Nitrates, Nitrites, Reservoirs, Lakes.

For the in situ measurement of nitrogen fixation in lake sediments, a method was developed which assures the rapid saturation with acetylene of the whole enzyme pool in the sediment and maintains the physical, chemical and biological environment nearly intact at the water-sediment interface. On the basis of seasonal measurements, the annual nitrogen fixation in the sediment was estimated in four types of shallow water ecosystem: the Keszthely Basin, Lake Balaton: 4.7 g N/sq m; Koros backwater reservoir: 6.5 g N/sq m; a polycultural fishpond: 0.49 g N/sq m; and a liquid manure oxidation fishpond: 0.61 g N/sq m. The amount of nitrogen fixed in the sediment of the Keszthely Basin was close to the fixation in the water column, while that fixed in the sediment of Koros backwater reservoir was considerably greater. A multiple regression analysis was made on the basis of synoptic studies on the vertical distribution of nitrogen fixation in the sediment, the pH, Eh, and concentration of organic N, NH4-N, NO3-N, and NO2-N in the interstitial water. The results indicate that nitrogen fixation is related to the depth, the NH4-N concentration, and the redox potential. The vertical distribution of nitrogen fixation cannot be explained in every case by the densities and distributional patterns of the Azotobacter and Clostridium populations. No correlation was observed between nitrogen fixation and total organic-C in lake sediment. A surprisingly close correlation was found between plankton primary production and the sedimentary nitrogen fixation in these lakes ($r = 0.85$, $y = 4.5 \times 0.85$). Short-term (4 h) in vitro studies revealed a glucose mediated increase of nitrogen fixation, but there was no NH4-N inhibition detected during this short incubation period. (Author's abstract)
W85-02903

**INVESTIGATION OF PLUNGING DENSITY CURRENTS GENERATED BY INFLOWS IN LAKES,**
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Hydromechanik und Wasserwirtschaft.
W. Hauenstein, and Th. Dracos.

Journal of Hydraulic Research, Vol. 22, No. 3, p 157-179, 1984. 8 Fig, 14 Ref. Swiss National Science Foundation grant 2.084-0.78.

Descriptors: *Water currents, *Bottom currents, *Lakes, *Inflow, Flow characteristics, Model studies, Turbulence, Density currents.

This study is a first attempt to investigate three-dimensional, submerged turbulent density currents over sloping bottom. The results given allow an approximate determination of characterisic velocitites, widths, depths and dilutions. The solutions are based on a simple integral model concept. This model concept allows the calculation of the steady and unsteady parts of flows with distinctive steady, as well as flows with distinctive unsteady buoyancy dominated regions. The limiting case implies that the upper end of the unsteady cap is stationary and coincides with the virtual origin of the flow. No detailed analyses concerning the similarity profiles could be carried out. Further investigation should focus on a better determination of the experimentally investigated coefficients of the model as well as the virtual origins. They should focus on a better determination of the experimentally investigated coefficients of the model as well as the virtual origins. They should include more detailed temperature profiles as well as velocity measurements in order to determine correct integration constants. Based on its basic concept, the model structure, such as the transition zone between steady current and unsteady cap as well as between momentum dominated and buoyance dominated steady flow should be investigated in more detail. (Baker-IVI)
W85-02930

**CRUSTACEAN PLANKTON IN NORTHEASTERN ONTARIO LAKES SUBJECTED TO ACIDIC DEPOSITION,**
Ontario Ministry of the Environment, Sudbury.
W. Keller, and J. R. Pitblado.
Water, Air and Soil Pollution, Vol. 23, No. 3, p 271-291, October, 1984. 10 Fig, 3 Tab, 47 Ref.

Descriptors: *Ontario, *Acid deposition, *Acid precipitation, *Plankton, *Crustacean, Lakes, Acid lakes, Cluster analysis, Cyclopoids, Physicochemical properties, Water temperature, Thermal stratification, Hydrogen ion concentration.

Planktonic crustaceans were sampled during the summer of 1981 in 249 northeastern Ontario lakes, including a large proportion of acidic lakes. Species cluster analysis showed a major species group common to most lakes. Two species subgroups were associated with more productive waters and less productive waters in the study area. Acidic lakes were characterized by reduced numbers of species. Stepwise multiple linear regression of physico-chemical lake characteristics against percent composition of individual species failed to explain much of the variation in species proportions. Variables related to lake thermal structure were most frequently the primary correlates with species proportions in near-neutral lakes while in acidic lakes the best statistical predictors of species percent composition were most often variables directly related to lake acidity. (Moore-IVI)
W85-02954

**RESPONSE OF THE COASTAL BOUNDARY LAYER TO WIND AND WAVES: ANALYSIS OF AN EXPERIMENT IN LAKE ERIE,**
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. J. Schwab, G. A. Meadows, J. R. Bennett, H. Schultz, and P. C. Liu.
Journal of Geophysical Research, Vol. 89, No. C5, p 8043-8053, September, 1984. 18 Fig, 2 Tab, 22 Ref.

Descriptors: *Lake Erie, *Coastal boundary layers, *Boundary layers, *Wind, *Waves, Currents, Water level, Storms, Surf zone, Lakes, Longshore currents, Wave height, Wind driven currents.

Wind, waves, currents, and water levels were measured near Lake Erie's southeastern shore during fall 1981. Data were recorded continuously at a wave research tower 6 km offshore at three Waverider buoys deployed around the tower and at three current meter moorings along a transect between the tower and the shore. During four storm episodes, wave and current data were also recorded from a dense array of instruments along a transect across the surf zone. A statistical analysis of the deep water data was performed, and histograms of meteorological parameters, wave parameters, and water level slope were plotted as a function of wind direction. The atmospheric boundary layer was usually unstable; on the average, the water was 2-3 C warmer than the air. This was true for all wind directions. At the tower the highest waves were associated with the greatest fetch distances to the WSW and WNW directions. The longest period waves were also associated with these wind directions. The mean water level slope was opposite the mean wind direction. This discrepancy is most likely due to small leveling errors in the water level gages. The variation of currents with wind direction was also examined. The currents are strongest when the winds are from the west, the quadrant with the strongest wind speeds. However, there are strong currents (5-10 cm/s) for all wind directions. The deep water currents are basically shore parallel, with the onshore/offshore component averaging 39% of the root mean square longshore component. Analysis of the four storm episodes reveals the influence of the offshore currents on the flow regime within the surf zone. Quantitative estimates of the longshore momentum balance outside the surf zone show wind stress and pressure gradient to be the dominant dynamic terms. Inside the surf zone, the radiation stress, wind stress, and bottom stress terms all have comparable effects and are usually larger than the acceleration and pressure gradient terms. In between, there is evidence of longshore flow reversals in the breaker zone and the effect of seiche-induced offshore currents on the near-shore flow regime. (Author's abstract)
W85-02960

**CHLORIDE BUDGET FOR THE MISSISSIPPI RIVER HEADWATERS TO MOUTH,**
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W85-02976

**MACROPHYTE COMMUNITY DYNAMICS IN DREDGED WISCONSIN LAKE,**
Wisconsin Geological and Natural History Survey, Madison.
For primary bibliographic entry see Field 4A.
W85-02984

**ZOOPLANKTON AND POTENTIAL FISH PRODUCTION IN LAKE ONTARIO,**
Canada Centre for Inland Waters, Burlington (Ontario).
U. Borgmann, H. Shear, and J. Moore.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 9, p 1303-1309, September, 1984. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Crustaceans, *Zooplankton, *Fish populations, *Lake Ontario, Lake fisheries, Lakes, Productivity, Commercial fishing.

The annual production of epilimnetic crustacean zooplankton in Lake Ontario was calculated from data on the abundance of each species and its eggs, and from predictions of egg development times. Bosmina longirostris is the most productive species at the nearshore stations whereas Diacyclops thomasi is the most productive offshore. Total crustacean zooplankton production is fairly uniform throughout the lake, both nearshore and offshore, with the possible exception of somewhat reduced production at the western end of the lake. Average total production was estimated at 15 g/sq m/yr. Using a recent estimate of particle particle-size-conversion efficiency in Lake Ontario, obtained from data on contaminant concentrations in aquatic biota, potential fish production in the lake is predicted for various sizes of fish. From published data on the commercial fish harvest from 1910 to 1930, a time period when commercial production was at a maximum, it is estimated that the past commercial harvest for pelagic species may have been 20% or more of the predicted potential production. (Author's abstract)
W85-02999

**INFLUENCE OF TEMPERATURE AND LIGHT ON RATES OF INORGANIC NITROGEN TRANSPORT BY ALGAE IN AN ARCTIC LAKE,**
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. C. Whalen, and V. Alexander.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 9, p 1310-1318, September, 1984. 5 Fig, 3 Tab, 39 Ref.

Descriptors: *Arctic lakes, *Nitrogen, *Solar radiation, *Water temperature, *Phytoplankton, Dissolved solids, Solute transport, Nitrates, Ammonia, Algae.

Nitrogen-15 tracer techniques were used to assess the individual effects of temperature and light on maximum rates of dissolved inorganic nitrogen (DIN) transport by phytoplankton in an arctic lake. Transport rates of NO3(-) and NH4(+) as a function of temperature in the range 3-30 C were adequately described by second- or third-order polynomial functions. The optimum temperature for DIN transport was greater than the ambient water temperature by as much as 13 degrees; thus, transport at the ambient water temperature averaged only 55-60% of optimum. Mean temperature coefficients for NO3(-) and NH4(+) transport in the temperature range > 0-15 C were 2.3 +/- 0.5 and 2.4 +/- 0.3. The ratio of dark to light-saturated DIN transport was used as a measure of light dependence in maximum rates of DIN transport. Values of the ratio of dark to light-saturated DIN transport for NO3(-) and NH4(+) were 0.15 +/- 0.09 and 0.41 +/- 0.11, indicating a stronger light dependence for NO3(-) than NH4(+) transport. In cases where dark NO3(-) transport was negligible, light was treated as a substrate and the Michaelis-Menten relationship fitted to the data. The half-saturation constant for light intensity in maximum NO3(-) transport ranged from 7 to 29 micro E/sq m/s, which was 6-31% of the photosynthetically active radiation at the lake surface. (Author's abstract)
W85-03000

**HISTORY AND PRESENT VEGETATION OF THE MACROPHYTE SWAMP AT PUKEPUKE LAGOON,**
Massey Univ., Palmerston North (New Zealand).
J. Ogden, and T. A. Caithness.
New Zealand Journal of Ecology, Vol. 5, p 108-120, 1982. 6 Fig, 2 Tab, 38 Ref, 2 Append.

Descriptors: *Pukepuke Lagoon, *New Zealand, *Swamps, *Vegetation, *History, Dune lakes, Lakes, Drainage effects, Macrophytes, Cattails, Hydroseral development, Water depth, Hydrogen ion concentration, Organic matter.

Pukepuke Lagoon is one of a series of shallow dune-lakes in the Manawatu district of New Zealand. Its open water area has been reduced by about 90% during the last century by sand drift from adjacent dunes, man-made changes to the local drainage, and the spread of macrophytes, especially Typha. Superimposed upon these changes are others due to the influx of exotic plants and animals. The vegetation of the macrophyte swamp is described in terms of the supposed sequence of hydroseral development. A reciprocal average ordination is used to describe the extensive Typha stands. The first axis of the stand ordination correlates with water depth, pH and the depth of the underlying organic matter. The second axis probably reflects stand disturbance. A species list is presented. (Author's abstract)
W85-03023

**BENTHIC FAUNAS OF FORESTED STREAMS AND SUGGESTIONS FOR THEIR MANAGEMENT,**

Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
J. S. Rounick, and M. J. Winterbourn.
New Zealand Journal of Ecology, Vol. 5, p 140-150, 1982. 3 Fig, 2 Tab, 38 Ref.

Descriptors: *Benthic fauna, *Streams, *New Zealand, *Stream management, Forests, Streambeds, Banks, Aquatic insects, Mayflies, Stoneflies, Caddisflies, Forestry.

The benthic invertebrate fauna was sampled and selected physical characteristics of the catchment, stream bed and adjacent banks were recorded in 43 first to third order streams in a variety of indigenous forest types and exotic pine plantations on the three main islands of New Zealand. The streams were investigated using a systematic survey technique. A small nucleus of common taxa was numerically dominant at most sites regardless of forest type. The mayfly, Deleatidium was found at 42 of the sites and was the most abundant taxon at 27. Other widely distributed genera were Nesameletus, Coloburiscus (Ephemeroptera), Stenoperla, Zelandoperla, Zelandobius (Plecoptera), Olinga and Hydrobiosis (Trichoptera). Numbers of invertebrate taxa and relative abundance of shredders (large particle detritivores) were not correlated with stream gradient but were correlated significantly with stream stability. The presence, in New Zealand, of a common, widely distributed core fauna, regardless of forest type, suggests that few, if any, species are dependent on particular types of terrestrial vegetation, and conversion from indigenous to exotic forest per se appears to have little impact on the nature of stream invertebrate communities. Combined physical-faunal surveys of the kind used in this study have the potential to identify streams which may require particular protection in relation to forestry practices. (Moore-IVI)
W85-03024

**WIND-INDUCED ENTRAINMENT IN A STABLY STRATIFIED FLUID,**
Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
For primary bibliographic entry see Field 2E.
W85-03037

**BACTERIAL ACTIVITY IN SEDIMENTS OF LAKES RECEIVING ACID PRECIPITATION,**
National Water Research Inst., Burlington (Ontario).
S. S. Rao, A. A. Jurkovic, and J. O. Nriagu.
Environmental Pollution (Series A), Vol. 36, No. 3, p 195-205, 1984. 6 Fig, 20 Ref.

Descriptors: *Lake sediments, *Bacteria, *Acid rain, *Ontario, *Silver Lake, *McFarlane Lake, Lakes, Sedimentation, Lake acidification, Water pollution effects, Organic matter, Hydrogen ion concentration.

Bacteriological data for water and sediment cores from some of the lakes receiving acid precipitation near Sudbury, Ontario show a strong relationship between lake acidification and bacteria. Certain physiological groups of bacteria in the water column are insensitive to changes in pH. In the case of respiring and aerobic heterotrophic bacteria, pH values below about 5.5 appear to be critical. Total bacteria in the waters of these lakes existed in the 1000000/ml range while the viable or active populations were about two orders of magnitude lower. A relationship between pH, bacterial populations, sediment microbial activity, and total organic matter was demonstrated. In the acid-stressed Silver Lake where pH readings were 3.8, the sediment respiration was 10-20% of that in the nonacid stressed McFarlane Lake, pH 7.2. A strong correlation was noted between pH and total organic matter in surficial sediments. (Baker-IVI)
W85-03047

**DISTRIBUTION OF FISHES IN THE BRODHEAD CREEK DRAINAGE MONROE COUNTY, PENNSYLVANIA,**
York Coll. of Pennsylvania. Dept. of Biological Sciences.
R. F. Denoncourt, W. F. Skinner, R. B. Domermuth, and J. M. Burke.
Proceedings of the Pennsylvania Academy of Science, Vol. 57, No. 1, p 56-60, 1983. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Fish, *Distribution, *Brodhead Creek, *Pennsylvania, Environmental effects, Flooding, Aquatic habitats, Trout, Shiners, Minnows.

Brodhead Creek drains 735 sq km in Monroe County, Pennsylvania. Historically, the cool, well oxygenated waters of the Brodhead and its tributaries have contributed to its reputation as an outstanding stocked-trout stream. The biota of the lower sections are subjected to and must be adapted to the frequent stresses of flood, scoured and shifting substrate, and changing habitats. In addition, the lower reaches have been subjected to several incidences of pollution. Surveys extended from 1940 to 1978 and included data from at least 68 collections in unpublished reports. Surveys in 1981 and 1982 at 20 locations brought the total recorded number of fish species to 35. Two new species, spotfin shiner (Notropis spilopterus) and eastern mudminnow, (Umbra pygmaea), were added to those found by other investigators, and the distribution of the bluespotted sunfish (Enneacanthus gloriosus) within the drainage was extended from one to four rather widespread locations. Trout are stocked throughout much of the drainage; young of the year were taken at many collection stations, indicating natural reproduction. (Moore-IVI)
W85-03067

**FISH BIOMASS OF DRAINED SMALL RESERVOIRS,**
Akademia Rolnicza, Poznan (Poland). Dept. of Inland Fisheries.
J. Mastynski.
Polskie Archiwum Hydrobiologii, Vol. 1, No. 31, p 69-76, 1984. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Fish populations, *Biomass, *Goluchow reservoir, *Malta reservoir, *Poland, Sport fishing, Carp, Bream, Reservoir fisheries, Productivity.

In 1979 in Poland, Goluchow reservoir was drained due to damage to the dam, and in 1980, Malta reservoir was drained because of an overhaul of the dam. Total drainage of the two small reservoirs made it possible to determine the components of the ichthyofauna and the biomass of the fish. The duration of filling of both reservoirs was the same, nine years. In Goluchow reservoir, 19 species of fish were collected, including 9 of the family Cyprinidae; 22 species, 13 of the family Cyprinidae were found in Malta reservoir. The yearly angling catch was determined on the basis of the number of licences granted, and data collected from 800 anglers on the Malta reservoir and 200 anglers on the Goluchow reservoir. The fishery production of artificial reservoirs is considerably higher than in natural lakes. During the drainage 17,767 kg of fish - 507.6 kg/ha were caught from 35.0 ha of the Goluchow reservoir. From 64.3 ha of the Malta reservoir, 28,171 kg of fish - 438.1 kg/ha were caught. In Goluchow, silver crucian carp was the dominant species, and in Malta, bream was the dominant species. (Moore-IVI)
W85-03070

**INVERTEBRATES, MACROALGAE, AND CHEMICAL FEATURES IN MORAINIC PONDS NEAR LAKES TEKAPO AND OHAU, INCLUDING NEW DISTRIBUTION RECORDS OF CRUSTACEA,**
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
C. W. Burns, M. I. Butler, and P. M. Cuttance.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 2, p 197-210, July, 1984. 5 Fig, 3 Tab, 32 Ref.

Descriptors: *New Zealand, *Ponds, *Invertebrates, *Algae, *Crustaceans, Moraines, Temporary ponds, Ecological distribution, Hydrogen ion concentration, Conductivity, Sodium, Chloride, Osmolality.

The invertebrates and macroalgae in 42 permanent and temporary ponds and kettles in glacial moraine south of Lake Ohau, and 36 sites in moraine west of Lake Tekapo, South Island, New Zealand, were sampled in December 1980, and taxonomic lists were compiled. Most organisms belonged to taxa characteristically found in shallow waters elsewhere in New Zealand, but new distributions for the rare cladocerans Neothrix armata, Monospilus dispar, and Ephemeroporus barroisi were recorded, and the presence of Simocephalus acutirostratus in New Zealand was confirmed. Darkly pigmented Daphnia carinata were recorded for the first time as also were co-occurring Boeckella triarticulata and Boekella dilatata. Cluster analysis of the data from both areas identified 3 groups of taxa with a high probability of co-occurring. Some species were absent from all the sites in one area but present at several sites in the other. This may reflect differences in adaptation to drought, or the limited sampling regime, but is also consistent with the areas being in different ecological districts. Ponds which still contained water in late autumn were sampled for pH (6.7-7.0), conductivity (K20, 17-79 micro S/cm), sodium (0.35-4.60 mg/L, chloride (0.89-5.68 mg/L), and osmolality (21-37 mOsM). (Author's abstract)
W85-03073

**DISTRIBUTION OF AQUATIC MACROPHYTES IN LAKE ALEXANDRINA, NEW ZEALAND,**
Centre for Resource Management, Canterbury (New Zealand).
J. Ward, and J. Talbot.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 2, p 211-220, July, 1984. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Macrophytes, *Lake Alexandrina, *New Zealand, Aquatic plants, Water depth, Waves, Biomass, Ecological distribution.

The macrophyte distribution of Lake Alexandrina (737 m a.s.l.), a small, homothermous, South Canterbury high-country lake, is closely related to depth. Shallow water communities, mostly dominated by Isoetes alpinus Kirk, extend to a depth of about 4 m, but do not grow above 0.7 m because of strong wave action. Mid-depth communities consist of a tall Elodea canadensis Michx./Myriophyllum triphyllum Orchard community between 2 and 4 m at the shallow northern end of the lake, large areas of Chara fibrosa var. acanthopitys (A.Br). Zanev. at the southern end, and a Myriophyllum triphyllum/Nitella hookeri A.Br. community at 2-6 m on the steeply descending eastern and western sides of the lake. Pure stands of Elodea canadensis may replace the last community, particularly on the eastern side. A deep water characean community of Chara globularis Thuill. and Chara corallina Kl. ex Willd. extends from 4 m to 10-11 m with 100% cover; C. corallina continuing sparsely to 16 m. Maximum above-ground biomass recorded for the summer 1982-83 was 1350 g/sq m (dry weight) for C. globularis and 1100 g/sq m for E. canadensis. (Author's abstract)
W85-03074

**ACTYLENE REDUCTION AND NITROGEN FIXATION POTENTIAL IN SOME EUTROPHIC LAKE SEDIMENTS,**
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
For primary bibliographic entry see Field 2K.
W85-03075

**WIND EFFECTS ON WATER AND SALT LOSS IN PLAYA LAKES,**
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen.
Journal of Hydrology, Vol. 74, No. 1/2, p 137-149, October, 1984. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Wind, *Playas, *Water loss, *Salinity, *Lake George, *New South Wales, *Australia, Water surface profiles, Infiltration, Slope.

The theory behind wind stress induced setup of water surface slope on a playa lake is reviewed. Due to the low gradient of the bottom in most playa lakes (1-20 cm/km), the advance and retreat of lake waters due to wind stress can expose or cover many square kilometers. It is even possible for the surface slope to exceed the bottom slope and thereby create a 'roving' lake. Such water movements can transport lake water over undersaturated 'shore' sediments and water can therefore infiltrate and be lost without an increase in lake salinity. This case is demonstrated with data from Lake George, New South Wales, Australia. Such wind effects need to be examined for their relation to the diagenesis of sediments, the composition of the bitterns, and the salt budget of playa lakes. (Author's abstract)
W85-03087

**PLANKTON AS A BASIS FOR THE ESTIMATION OF THE POSSIBLE NATURAL FISH PRODUCTIVITY OF DURANKULAK LAKE (PLANKTONT KATO BAZA ZA OTSENKA NA POTENTSIALNATA ESTESTVENA PIBOPRODUKTIVNOST NA KRAIMORSKOTO EZERO DURANKULAK),**
V. T. Naidenov, and D. A. Saiz.
Hydrobiology (Bulgarian Academy of Science), Vol. 21, p 3-13, May, 1984. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Durankulak Lake, *Plankton, *Fish populations, *Productivity, Phytoplankton, Zooplankton, Biomass, Commercial fisheries, Lakes, Standing crop, Fish food.

The studies on the hydrochemistry, biomass and abundance of phyto and zooplankton of Durankulak lake (no water outflow) are used in the attempted estimation of the productive capabilities of the producers as well as first to third order consumers and the possible commercial fish catches. The estimation goes by seasons and years. The equation: R = Q.E/10,000 x (B(P/B))/D x tC, where R is the possible catch, B - the biomass, Q - the total water volume, C - the assumed utilizability of the nutrition basis, E - expected catch as a part of the entire fish production, t - duration of the period of study, D - nutrition coefficient, is used to determine the possible catch which depends on the total water volume, biomass, production, degree of consumption of trophic organisms, nutrition coefficient and technical capabilities for a complete catching of the entire fish standing crop. Having in mind that the Durankulak lake biocenoses are in a climax condition with a relatively constant production level it is estimated that if no alterations of the fish are made the annual plankton-determined fish catch should be within 19 to 62 t. In the case of better utilization of the nutrition basis (mainly phytoplankton and macrophytes) it can be increased up to 120 t. (Author's abstract)
W85-03099

**CHARACTERISTICS OF AUTOPURIFICATION IN THE OSSAM RIVER, A TRIBUTARY OF THE DANUBE (EINIGE BESONDERHEITEN IN DER SELBSTREINIGUNG DES DONAUZUFLUSSES OSSAM),**
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W85-03100

**SOME PRINCIPLES OF THE STRUCTURE AND ORGANIZATION OF THE HYDROBIOLOGICAL MONITORING OF RIVERS (O NEKOTORYX PRINTSIPAX STRUKTURY I ORGANIZATSII GIDROBIOLOGICHESKOGO MONITORINGA REK),**
For primary bibliographic entry see Field 7A.
W85-03102

**HYDROBIOLOGICAL AND SAPROBIOLOGICAL ALTERATIONS IN THE TUNJA RIVER. I. 1955 - 1967 (TENDENTSII V IZMENENIYATA NA KHIDROBIOLOGICHNOTO I SAPROBIOLOGICHNOTO S'STOYANIE NA REKA TUNDZHA. I. 1955-1967 G),**
For primary bibliographic entry see Field 5B.
W85-03106

**TEMPERATURE CHARACTERISTICS, ANNUAL HEAT STORAGE, AND RIVER DIVERSION INFLUENCE ON A MONOMICTIC LAKE,**
Geological Survey of New South Wales, Sydney (Australia).
T. J. Loranger, and D. F. Brakke.
Northwest Science, Vol. 58, No. 3, p 222-229, August, 1984. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Lake Whatcom, *Washington, *Nooksack River, *Temperature distribution, *Heat storage, Birgean heat budgets, Lakes, Thermal stratification, Metalimnion.

Temperature and heat content characteristics were determined for Lake Whatcom, in the Puget Sound lowland of Washington state, and the effect of diversion of Nooksack River water into the lake since 1962 was assessed. Temperature data obtained during the periods 1962-1972 and 1979-1981 were used to calculate Birgean heat budgets for the lake for eight separate years. Lake Whatcom reached maximum thermal stratification by mid-August; a distinct metalimnion was consistently present by 1 June of each year. The mean maximum heat storage for the 8 yr studied was 49,400 cal/cm per year. The mean minimum winter heat storage for the study years was 26,300 cal/sq cm per year. The resulting mean annual change in heat storage for the 8-yr period was 23,100 cal/sq cm per year. Diversion of Nooksack river water at a rate of 231,000 cu m/day, which has occurred from spring through fall since 1962, caused a negligible effect on heat storage in the lake. The maximum amount of water diverted into Lake Whatcom before 1 August in any year was 34 million cubic meters. This volume causes a 0.11 C drop in lakewide temperature at the time of maximum heat storage in the lake. (Rochester-IVI)
W85-03110

**ALGOLOGICAL INVESTIGATIONS IN THE WATERS OF THE TISZA BASIN AT ALPAR,**
Jozsef Attila Univ., Szeged (Hungary). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W85-03115

**STUDIES ON THE QUALITATIVE AND QANTITATIVE COMPOSITION AND THE SEASONAL CHANGES OF PHYTOPLANKTON AT THREE SAMPLING AREAS OF THE DEAD TISZA AT LAKITELEK,**
Lower-Tisza District Water Authority, Szeged (Hungary).
For primary bibliographic entry see Field 5C.
W85-03117

**DIEL AND SEASONAL CARBON BUDGETS IN TWO COLD SPRING ECOSYSTEMS,**
Idaho Div. of Environment, Pocatello.
J. A. Perry II, and F. L. Rose.
Archiv fur Hydrobiologie, Suppl. 69, No. 3, p 333-363, September, 1984. 10 Fig, 12 Tab, 66 Ref.

Descriptors: *Ecosystems, *Cold springs, *Carbon cycle, Springs, Seasonal variations, Macrophytes.

The assumption of constancy in spring stream organic carbon budgets was tested. Cold springs were shown not to be constant temperature analogs of either streams or marshes. They are provided with the energy subsidy of velocity, but they have primary production rates similar to marshes. Standing crops of living and detrital organic carbon are similar to marshes; primary production per unit carbon is similar to streams. Living biomass was reduced in fall, detrital biomass was almost totally processed and/or flushed over winter. Cold spring streams are discrete functional units, yet have properties common to several other aquatic environments. (Baker-IVI)
W85-03122

**EFFECTS OF ACIDIFICATION AND PHOSPHORUS ADDITION ON PHYTOPLANKTON BIOMASS AND PRODUCTIVITY IN A CIRCUM-NEUTRAL MESOTROPHIC LAKE RECEIVING ACID PRECIPITATION,**
West Virginia Univ., Morgantown.
For primary bibliographic entry see Field 5C.
W85-03123

**LIMNOLOGY OF THE KERN RIVER (SOUTHERN CALIFORNIA),**
Kern County Water Agency, Bakersfield, CA.
G. Hill, and H. Rai.
International Revue de Gesamten Hydrobiologie, Vol. 69, No.5, p 653-678, 1984. 17 Fig, 14 Tab, 20 Ref.

Descriptors: *Kern River, *Limnology, Primary productivity, Nitrates, Phosphates, Geology, Morphology, Rivers.

The Kern River, in Southern California, was studied for 20 months. Geological and morphological effects on water chemistry were noted. Chemically the Kern River is a Ca-Na-HCO3 system with an average total filterable residue of 100 mg/l. Primary production in Kern River water was limited by nitrates and, occasionally, by phosphates. Planktonic biomass was highest in February-March and Melorisira granulata was the dominant species. Chlorophyll a averaged 4.17 microg/l. Radioactivity was low. Carbon forms were influenced by runoff with labile carbon being associated with the saprobic bacteria. Three habitat types of flora were encountered. Total fish potential was largely restricted to man-made Lake Isabella. Of the various changes which might affect the fragile river system, industrial waste is the most likely to make an adverse or harmful change. Uranium mine waste has been shown to affect respiration of natural algal populations during production studies. Another industry of concern is the industrial dump which is operating and expanding in the Kern River watershed. Increasing demands on the Kern River, coupled with industrial and domestic impacts which are increasing, have the potential to do great injury to the river and the areas it serves. (Baker-IVI)
W85-03124

**ASSESSMENT OF COMPONENTS CONTROLLING PHYTOPLANKTON PHOTOSYNTHESIS AND BACTERIOPLANKTON PRODUCTION IN A SHALLOW, ALKALINE, TURBID LAKE (NEUSIEDLERSEE, AUSTRIA),**
Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Limnologie.
M. Dokulil.
International Revue de Gesamten Hydrobiologie, Vol. 69, No.5, p 679-727, 1984. 24 Fig, 13 Tab, 193 Ref.

Descriptors: *Phytoplankton, *Photosynthesis, *Lakes, *Turbidity, *Neusiedlersee, *Austria, Wind, Waves, Bacteria.

Various aspects of phytoplankton photosynthesis were investigated between 1968 and 1980 in Neusiedlersee, Austria, a shallow, well mixed lake with much turbidity resulting from frequent resuspension of inorganic sediment particles. One of the most important factors is wind induced wave action that disturbs the lake bottom. The turbulent conditions favor small centric diatoms and chlorococcalean phytoplankton associations. There is little photosynthesis during the winter. Its rate increases during spring and varies throughout the rest of the year. Nanoplankton contributed considerably to total photosynthesis. Specific photosynthesis per unit chlorophyll a is governed by factors such as temperature, nutrient supplies, chlorophyll content of the cells and physiological conditions. Bacterial numbers and production are high in Neeusiedlersee. Bacterial cell counts are correlated with turbidity. The results of this study are compared with data from several other shallow lakes and discused. A classification of shallow water bodies is attempted. (Baker-IVI)
W85-03125

**MULTICOMPONENT MODEL OF PHOSPHORUS DYNAMICS IN RESERVOIRS,**
Najarian and Associates, Eatontown, NJ.
T. T. Griffin, and R. A. Ferrara.

Water Resources Bulletin, Vol. 20, No. 5, p 777-788, October, 1984. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Reservoirs, *Model studies, *Phosphorus, Nutrients, Eutrophication, Impoundments, Water quality, Trophic levels.

An improved model is developed for time variable, long-term simulation of trophic state in reservoirs with fluctuating inflow and outflow rates and volume. The model as developed represents the phosphorus cycle in two layer (i.e., epilimnion and hypolimnion) reservoirs. The model is designed to simulate seasonally varying reservoir water quality and eutrophication potential by using the phosphorus state variable as the water quality indicator. Long term simulation with fluctuating volumes and variable influent and effluent flow rates are feasible and practical. The model utility is demonstrated through application to a pumped storage reservoir characteristic of these conditions. (Baker-IVI)
W85-03144

**DETERMINATION OF THE HYDROGEOLOGIC PROPERTIES OF LAKEBEDS USING OFFSHORE GEOPHYSICAL SURVEYS,**
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
K. R. Bradbury, and R. W. Taylor.
Groundwater, Vol. 22, No. 6, p 690-695, November-December, 1984. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Lake beds, *Groundwater, Lakes, Permeability coefficient, Hydrogeologic properties.

A correlation between longitudinal conductance, a geoelectric parameter, and lakebed leakance may provide a rapid and inexpensive method for estimating lakebed hydrogeological properties using data collected by offshore seismic and electrical surveys. A test of the method at three study sites in Lake Michigan shows a positive linear relationship between the logarithm of longitudinal electrical conductance, S, and the logarithm of lakebed leakance at the three sites. Leakance is a measure of the potential for hydraulic connection; thus the S values may be used to spatially map the relative hydraulic connection between lakes and aquifers. Offshore geophysical surveys are relatively fast and inexpensive when compared with direct measurements of offshore lakebed properties. Therefore, offshore electrical surveys, combined with seismic reflection data, provide a promising tool for lake aquifer studies. (Baker-IVI)
W85-03148

**ISOTOPE GEOCHEMISTRY OF STRATIFIED LAKE 'A', ELLESMERE ISLAND, N.W.T., CANADA,**
Calgary Univ. (Alberta). Dept. of Geography.
M. O. Jeffries, H. R. Krouse, M. A. Shakur, and S. A. Harris.
Canadian Journal of Earth Sciences, Vol. 21, No. 9, p 1008-1017, September, 1984. 13 Fig, 5 Tab, 34 Ref.

Descriptors: *Lake A, *Ellesmere Island, *North West Territory, *Stratified lakes, Lakes, Stratification, Salinity, Temperature, Acidity, Tritium, Seawater.

Lake A on Ellesmere Island was created by postglacial uplift and isolation of a seawater basin a few thousand years ago. In comparison with average seawater the ionic composition of the underlying water in Lake A is slightly modified in cationic composition and drastically modified in anion composition, with marked depletions of sulfate and enrichments of dissolved carbonate species. These enrichments are due to bacterial sulfate reduction and associated oxidation of organic matter. Some sulfide was apparently reoxidized. It is possible that prior to stratification there were extensive hydrogen sulfide and perhaps carbon dioxide emissions to the atmosphere. Alternatively, sulfide minerals may have been precipitated. Despite these uncertainties, the marked depletions in sulfate coupled with the isotopic data indicate that anaerobic microbiological activity has been extensive during the lake's history. Mixing phenomena in the transition zone are hard to assess. The ionic and stable isotope compositions of the deeper trapped seawater indicate some modification of the original seawater in the basin. (Baker-IVI)
W85-03195

**SEASONAL VARIATIONS OF 210-PB AND 210-PO CONCENTRATIONS IN AN OLIGOTROPHIC LAKE,**
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. W. Taylor, and A. W. Andren.
Geochimica et Cosmochimica Acta, Vol. 48, No. 10, p 2053-2063, October, 1984. 4 Fig, 2 Tab, 36 Ref. EPA grant R806878-01-06.

Descriptors: *Lead radioisotopes, *Polonium radioisotopes, *Crystal Lake, *Wisconsin, Lake sediments, Particulate matter, Vertical distribution, Seasonal variation, Oligotrophic lakes, Biogeochemistry.

The vertical distribution of Pb-210 and Po-210 in the dissolved and the particulate phases were measured in Crystal Lake, Wisconsin, to examine the spatial and temporal variability during the seasonal cycle of this oligotrophic lake. A comparison of the values estimated for the atmospheric flux and sediment accumulation of Pb-210 suggests that the atmosphere is the principal source of Pb-210 to Crystal Lake. The atmospheric flux of Pb-210 at this site is about 0.70 pCi/sq cm/yr compared to only about 0.06 pCi/sq cm/yr for Po-210. Most of the Po-210 in Crystal Lake is consequently produced in situ from radioactive decay of Pb-210. The removal rates of Pb-210 and Po-210 from the water column to the sediments varied temporally by nearly an order of magnitude. During transient periods of high plankton productivity, a large net flux of Pb-210 and Po-210 into the sediments occurred. It was during these short-lived events that most of the annual net removal of these nuclides occurred. Biological removal processes acted to rapidly deplete the standing crops of both Pb-210 and Po-210 in the water column. For Pb-210, replenishment of the water column appeared to occur mainly from atmospheric input. In the case of Po-210, there seemed to be a very efficient biogeochemical recycling scheme operating. Particulate Pb-210 was rapidly stripped from the water column during turnover. As the thermocline quickly eroded, small detrital particles previously trapped in surface water may have been released to deeper water and efficiently removed Pb-210 via an aggregation-scavenging mechanism. Boundary scavenging of dissolved Pb-210 may also be an important removal mechanism, but its magnitude is unknown. Although both Pb-210 and Po-210 are highly reactive with respect to their rapid removal from Crystal Lake, the 0.095 yr mean removal residence time of Pb-210 was nearly a factor of 3 less than the 0.26 yr mean value for Po-210. Such differences in the biogeochemistry of these genetically coupled nuclides demonstrate the complexities involved in predicting the fate of reactive chemical constituents in a seemingly well-defined lake system. (Baker-IVI)
W85-03212

## 2I. Water In Plants

**INFLUENCE OF SOIL DRYING ON THE WATER RELATIONS AND GROWTH OF DOUGLAS FIR (PSEUBOTSUGA MENZIESII (MIRB.) FRANCO) (INFLUENCE DU DESSECHEMENT DU SOL SUR LE FONCTIONNEMENT HYDRIQUE ET LA CROISSANCE DU DOUGLAS (PSEUDOTSUGA MENZIESII (MIRB.) FRANCO)),**
Centre National de Recherches Forestieres, Seichamps (France). Station de Sylviculture et de Production.
G. Aussenac, A. Granier, and M. Ibrahim.
Acta Oecologia-Oecologia Plantarum, Vol. 5, No. 3, p 241-253, 1984. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Soil water, *Soil moisture deficiency, *Trees, *Plant growth, Soil properties, Drought, Fir, Water potential.

Four 22 yr old douglas fir trees were studied to determine the influence of soil drying conditions on water relations and growth. The trees were growing inside 2 lysimeters whose watering was regulated. The predawn tree water potential was in balance with the soil water potential at the level where the absorption by root occurs and soil moisture is maximum. Existence of close relationships between predawn potential and soil water reserve is shown. Capillary rises were measured and reached 0.5 mm/day under driest soil conditions. A study of the evolution of the ratio ETR/ETP under decreasing soil moisture conditions shows that this ratio decreased rapidly and reached 0.35 when predawn potential was lower than -5 bars. From the stated relations a tentative model is proposed for the variations of the soil water reserve and of the predawn potential as related to the rainfall and the potential evapotranspiration. For both trees in a drying phase, the stem circumference growth was stopped at a predawn potential of -3 bars, beyond this threshold and down to -12 bars there was a shrinkage of the stem. After watering back to the field capacity, the stem circumference came back to the starting level, then increased and nearly equalized the stem circumference growth of the trees of the control group, for the dominant tree. In the case of the suppressed one the stem circumference growth was rapidly stopped. (Baker-IVI)
W85-02716

**WATER RELATIONS OF QUERCUS PALUSTRIS: FIELD MEASUREMENTS ON AN EXPERIMENTALLY FLOODED STAND,**
Washington State Univ., Pullman. Dept. of Forestry and Range Management.
R. A. Black.
Oecologia (Berlin), Vol. 64, No. 1, p 14-20, September, 1984. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Flooding, *Plant growth, *Trees, Vegetation, Oak, Flood tolerance, Flood plains.

Field measurements of water relations were used to examine the response of mature Quercus palustris, a flood tolerant tree, to experimental flooding treatments. Flooding treatments included flooding in the dormant season, short-term flooding in the growing season and long term continuous flooding. Quercus palustris apparently is a stress-tolerator in the flood plain environment. Flooding in the dormant season had minimal effect on subsequent growing season water relations of Q. palustris. Q. palustris is also well adapted to unpredictable flooding in the growing season which is common on the Mississippi flood plain. The stomatal closure caused by flooding in the growing season was reversed within 10 days. Q. palustris similarly tolerated the continued stress of long term flooding in the growing season. Long term flooding in the growing season had no effect on tree water relations. Continuous flooding for extended periods of time (less than 3 yr) will result in tree mortality. Prior to death of the tree, flooding in the growing season apparently reduced the reproductive fitness of Q. palustris. While tolerating the stress of flooding in the growing season, these flooding stresses caused a reduction in the number of flowers produced and an abortion of the previous years mature fruits. These reductions in reproductive fitness may explain the relative positions of species on flood plains where mature trees are apparently capable of tolerating flooding of variable occurrence and duration but where seedlings are rarely encountered. (Baker-IVI)
W85-02814

**FIELD WATER RELATIONS OF SONORAN DESERT ANNUALS,**
Utah Univ., Salt Lake City. Dept. of Biology.
I. N. Forseth, J. R. Ehleringer, K. S. Werk, and C. S. Cook.
Ecology, Vol. 65, No. 5, p 1436-1444, October, 1984. 5 Fig, 3 Tab, 40 Ref. Dept. of Agriculture grant 5901-0410-8-0093-0.

Descriptors: *Desert plants, *Leaves, *Water potentials, *Sonoran Desert, Seasonal variation, Precipitation, Drought resistance, Plant growth.

Field water relations were examined in winter and summer annuals of the Sonoran Desert. Both groups were characterized by low below ground biomass allocation. Leaf conductances and leaf water potentials are high in desert annuals, and in some circumstances and species, may be unusually high. This is consistent with the idea that these annuals are ephemeral and drought-evading. It is clear that some winter and summer desert annuals are capable of tolerating low leaf water potentials and therefore are not drought-evading in the traditional sense. Root/shoot ratios of both winter and summer desert annuals are quite low, suggesting that only a small fraction of the carbon gained is used for water acquisition; carbon is instead used for vegetative and reproductive growth. (Baker-IVI)
W85-02817

**GEOMORPHIC AND VEGETATIVE CHARACTERISTICS ALONG THREE NORTHERN VIRGINIA STREAMS,**
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W85-02834

**STORED AVAILABLE SOIL WATER AND THE FALLOW/RECROP DECISION-CRITICAL LEVEL APPROACH,**
North Dakota State Univ., Fargo. Dept. of Soil Science.
R. J. Goos, B. E. Johnson, F. J. Sobolik, and R. P. Schneider.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1134-1137, 1984. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Soil water, *Recropping, *Crop production, *Fallowing, Wheat, North Dakota, Water storage, Soil-water-plant relationships.

The amount of stored soil water at seeding has long been appreciated as a critical factor in the success of annual spring wheat (Triticum aestivum L.) production in the semiarid region of the Northern Great Plains. Stored available soil water at seeding, growing season precipitation, and grain yield data from 53 spring wheat experiments in western North Dakota were analyzed by both multiple regression and an interaction chi-square approach. Soil types were generally fine-loamy, mixed Typic Haploborolls or Argiborolls. Regression equations explained too little of the variability of the data to be useful in drawing practical guidelines for future fallow/recrop decisions. The results suggest that stored soil moisture data are better analyzed by the interaction chi-square test, the results of which provide easy-to-interpret guidelines for making future fallow/recrop decisions. For example, for a minimum acceptable recrop wheat yield of 1350 kg/ha, the following critical levels were defined: stored available soil water at seeding less than 6.4 cm, crop failure is likely and summerfallow is advised; stored available soil moisture 6.4 to 9.4 cm, approximately equal odds of crop failure or success; stored available soil moisture > 9.4 cm, crop success is likely and recropping is advised. (Author's abstract)
W85-02874

**ALFALFA GROWTH AND SOIL OXYGEN DIFFUSION AS INFLUENCED BY DEPTH TO WATER TABLE,**
Agricultural Research Service, Orono, ME. New England Plant, Soil and Water Lab.
For primary bibliographic entry see Field 2G.
W85-02877

**XYLEM WATER FLOW IN A CRACK WILLOW TREE (SALIX FRAGILIS L.) IN RELATION TO DIURNAL CHANGES OF ENVIRONMENT,**
Vysoka Skola Zemedelska, Brno (Czechoslovakia). Inst. of Forest Ecology.
J. Cermak, J. Jenik, J. Kucera, and V. Zidek.
Oecologia, Vol. 64, No. 2, p 145-151, October, 1984. 4 Fig, 4 Tab, 34 Ref.

Descriptors: *Willow trees, *Diurnal changes, *Transpiration, *Vascular tissues, Marshes, Meteorologic conditions, Heat balance, Plant physiology, Trees, Plant tissues.

The diurnal course of the xylem water flow in a solitary Salix fragilis L. tree in a wet grassland was measured using the tissue heat-balance method. There was considerable variation due to meteorological factors. Maximum flow rate was 0.4 kg/h/sq m of crown projection area, or 5.9 kg/h/kg leaf dry weight. The daily total was 2.4 kg/sq m/day or 36 kg/kg/day. Water flow decreased immediately at the tree base and at the branches after start of rain, and in a branch, after cutting it off: the time constant of the system was 600-700 s in both cases. The part of the crown oriented to the sun transpired up to ten times as much as the shaded part. Over 70% of the total cross-sectional area of the conductive xylem vessels of the trunk was used by the transpiration flow. The water content of the trunk tracked the diurnal changes of the xylem water flow rate with a short time-lag. During the day, 1% of the trunk volume was temporarily exploited as water reserve, an amount equalling 3% of daily water loss. The stereometric configuration of the crown significantly influenced its water loss. During the summer period, about 33 mature (polycormic) trees per ha may drain 100% of water consumed by the present-day sedge-grass marsh. (Author's abstract)
W85-02900

**INFLUENCE OF WATER ON CO2 EXCHANGE IN THE LICHEN PARMELIA PRAESIGNIS NYL.,**
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
S. O. Link, and T. H. Nash, III.
Oecologia, Vol. 64, No. 2, p 204-210, October, 1984. 2 Fig, 1 Tab, 27 Ref. NSF grant DEB 792153.

Descriptors: *Plant physiology, *Gas exchange, *Carbon dioxide, *Lichens, Respiration, Water content, Photosynthesis.

Net photosynthetic rates for the lichen Parmelia praesignis Nyl. were obtained as a function of 5 light levels, 5 temperature levels, and of water content as thalli dried from saturated conditions. Data are described as second order polynomials in the light, and as saturation curves in the dark. Rates in the light were depressed at high water contents reaching maximal rates between 110% and 180% water content and declining as thalli dried. Physiological parameters were derived from the drying curves to investigate temperature and light interactions. Dark respiration parameters are the maximal rate, the water content where the rate is half-maximal, the water content at which respiration is zero, and the maximal water efficiency. In the light, parameters are the maximal net photosynthetic rate, the water content at the maximal rate, the water compensation point, the maximal water efficiency, and the sensitivity of net photosynthesis to change in water content. Values of half-maximal rate water contents for respiration were found to increase as temperatures increased. The greatest maximal net photosynthetic rate occurred at higher temperatures as the light intensity increased. In the light, maximal water efficiency and the sensitivity to changes in water content were generally maximal at temperatures yielding the greatest maximal net photosynthetic rates. (Author's abstract)
W85-02901

**WATER RELATIONS OF OAK SPECIES ON AND ADJACENT TO A MARYLAND SERPENTINE SOIL,**
Towson State Univ., Baltimore, MD. Dept. of Biological Sciences.
J. C. Hull, and S. G. Wood.
American Midland Naturalist, Vol. 112, No. 2, p 224-234, October, 1984. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Oaks, *Soil water potential, *Plant water potential, *Serpentine soils, *Maryland, Ecological distribution, Xylem water potential, Stomatal conductance.

The predominant oaks of the Maryland Piedmont (Quercus alba and Q. velutina) do not occur on serpentine soils. On serpentine sites they are replaced by Q stellata and Q. marilandica. Soil and plant water relations were measured to evaluate water as a limiting factor to distribution of oaks on serpentine soil. May through August soil water potentials of serpentine soils were not lower than adjacent nonserpentine soils. Dawn xylem water potentials of oaks on serpentine soils were similar to nonserpentine oaks during early and midsummer. By late summer, water potentials of the oaks on serpentine sites were higher. Dawn xylem water potentials and soil water potentials were significantly correlated for all species. A significant correlation between xylem water potential and stomatal conductance was found for the oaks on the serpentine soils. No such correlation was found for oaks on nonserpentine soil, but a xylem water potential threshold for stomatal closure was observed. Despite differences in their responses to moisture availability, water does not appear to be in the environmental factor responsible for the distributional pattern of these species. (Author's abstract)
W85-03015

**HYDROECOLOGY OF THE GRASS-ASSOCIATIONS FOUND AT THE DAMS ALONG THE UPPER-TISZA,**
Jozsef Attila Univ., Szeged (Hungary). Dept. of Botany.
Gy. Bodrogkozy.
Tiscia (Szeged), Vol. 19, No. 2, p 89-111, 1984. 8 Fig, 8 Tab, 30 Ref.

Descriptors: *Grasses, *Hydroecology, *Dams, *Tisza, *Hungary, Floods, Slopes, Ecological distribution, Soil water.

To this day, the grass stands developing at the dams of the Upper Tisza-valley by means of sowing performed close to one century ago, have come close to the populations of the alpine meadows. Their zonal arrangement is determined by the frequent, but short-termed inundations and the exposition of the dam-slope. A significant variation was demonstrable compared to the similarly located dam grass zones found at the Southern Tiszavalley. 1. Alopecuro-Arrhenatheretum developed on the effect of repeating floods in the lower zones of the Northern-, North-Eastern dam-slope. The helo-hygrophyton and hygrophyton representatives were dominating. 2. Pastinaco-Arrhenatheretum was found located at the upper zone of the dam-slope. Depending on the moisture conditions, three sub-associations could be distinguished and the species belonging to the various subunits of the hygro-mesophyton category were demonstrable. 3. The Lolio-Plantaginetum developed on enhanced zoogenic effect at the dam's Western-South-Western flood-protected area. 4. The zone of the Salvio-Festucetum rupicolae could be differentiated into four sub-associations and occupied the central and upper protected dam zone. Their species components were meso-xerophyton representatives. (Author's abstract)
W85-03118

**EFFECTS OF COLD SOIL ON WATER RELATIONS AND SPRING GROWTH OF DOUGLAS-FIR SEEDLINGS,**
Pacific Northwest Forest and Range Experiment Station, Wentachee, WA.
W. Lopushinsky, and M. R. Kaufmann.
Forest Science, Vol. 30, No. 3, p 628-634, 1984. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Soil temperature, *Transpiration, *Plant growth, *Fir, Water stress, Plant physiology.

Effects of low soil temperature on the water relations, shoot growth, and root growth of Douglas-fir seedlings were studied to evaluate the significance of reduced water uptake and growth in seedlings outplanted in cold soils. Transpiration rate was significantly correlated with soil temperature and declined linearly with decreasing temperatures. Xylem pressure potential of seedlings in cold soil that were exposed to moderate evaporative demand averaged -15.4 bars for the 4 days it was measured, compared to -11.1 bars for seedlings in warm soil. Except for the initial decline in P for

the warm soil group, P for both groups remained essentially constant throughout the test period. Xylem pressure potential of seedlings in cold soil that were exposed to high evaporative demand averaged -20.0 bars, compared to -13.4 bars for seedlings in warm soil. Stomatal conductances of seedlings in the cold soil groups averaged 50% or less of those in the warm soil groups. Low soil temperatue delayed bud burst, reduced shoot growth, and completely prevented root growth. (Baker-IVI)
W85-03128

## 2J. Erosion and Sedimentation

**SUSPENDED SEDIMENT RESPONSES IN A WIND-DOMINATED ESTUARY OF THE TEXAS GULF COAST,**
Minerals Management Service, Corpus Christi, TX.
G. L. Shideler.
Journal of Sedimentary Petrology, Vol. 54, No. 3, p 0731-0745, September, 1984. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Suspended sediments, *Wind, *Estuaries, *Texas, *Corpus Christi Bay, Bays, Sediments, Waves, Storms, Water circulation, Turbidity, Water density.

Hydrographic and suspended-sediment characteristics of Corpus Christi Bay indicate the dominant influence of wind as a forcing agent in regulating sedimentary processes within the shallow, restricted estuaries characteristic of the Texas Gulf Coast. Surface-sediment dispersal patterns within the bay primarily reflect wind direction. Offshore-directed northerly winds characteristic of winter storm conditions result in dispersal patterns that are substantially different than the patterns associated with onshore-directed prevailing southeasterly winds, which are characteristic of the summer season. Wind direction influences sediment dispersability establishing the direction of wind-driven currents, set-up effects, and wave propagation. In winter, these factors determine the most intense areas of bayfloor sediment resuspension and the direction and efficiency of both tidal and nontidal water-exchange and sediment movement between the bay and adjoining water bodies. Suspended-sediment characteristics within the water column are not discernibly influenced by baywater density, which was generally vertically homogeneous. Baywater turbidity is directly related to mean wind speed, and is a relatively short-term response parameter. It is influenced mainly by cumulative wind-speed effects that occur within a 30 hr period prior to observation, which is more influential than the immediate wind effects at the time of observation. This temporal relationship largely reflects the water column residence time of muddy bayfloor sediments episodically resuspended by wind generated wave activity. The water column turbidity structure ranges from increasing turbidity gradients with depth to isoturbid conditions. Texturally, the water column suspensate consists of poorly sorted clay size to very fine silt size detritus. (Baker-IVI)
W85-02835

**REACTIVATION SURFACES IN SUBTIDAL CHANNEL DEPOSITS, OOSTERSCHELDE, SOUTHWEST NETHERLANDS,**
Institute of Earth Sciences, Utrecht (Netherlands). Comparative Sedimentology Div.
T. de Mowbray, and M. J. Visser.
Journal of Sedimentary Petrology, Vol. 54, No. 3, p 811-824, September, 1984. 10 Fig, 24 Ref.

Descriptors: *Oosterschelde, *Netherlands, *Tidal deposits, *Reactivation surfaces, Erosion surfaces, Deposition, Sedimentation.

Recognition of unsteadiness in flow velocities is an important factor in the identification of tidal deposits. One consequence of such unsteadiness is the production of reactivation surfaces - erosion surfaces developed within a cross-stratified set. Reactivation surfaces can be produced in a unidirectional flow system, by the migration of a faster-moving megaripple over a slower one ('overtaking'). The form of the surface is dependent upon the relative sizes of the two megaripples concerned and the flow conditions under which they migrate. Other types of reactivation surfaces are produced by the action of a subordinate current, which erodes the lee side of the dominant-current megaripple. The morphology of the reactivation structures depends on the size of the megaripples concerned (the examples considered here had heights in the range 0.25-2.5 m) and, most importantly, on the relative strengths of the dominant and subordinate currents. Where the subordinate current is relatively weak only the tops of the dominant-current foresets are eroded. With increasing subordinate-current strength, the whole foreset height is subjected to erosion, and a large angular discordance is produced between the large-scale foresets and the reactivation surface. Such strong erosion drastically alters the megaripple relief - the lee-side slope is much reduced. Recovery of the lee side during the subsequent dominant-current phase is gradual, as can be seen from the development of small-scale structures immediately overlying the reactivation surfaces. The regular variation in the strength of the subordinate current during the neap/spring cycle is often reflected in the morphology of the reactivation surfaces. In such examples, the reactivation surfaces formed during spring-tide periods have a large angular discordance with the foresets, indicating that there was considerable erosion by the subordinate current. Reactivation surfaces formed during periods between spring and neap, in contrast, are developed only in the upper parts of the foresets, suggesting that subordinate-current erosion was relatively modest, while the deposits of the neap tides themselves show no evidence of any erosion by the subordinate current. (Author's abstract)
W85-02836

**SUSCEPTIBILITY OF AGRICULTURAL SOILS TO INTERRILL EROSION,**
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. D. Meyer, and W. C. Harmon.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1152-1157, September/October 1984. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Erosion, *Interrill erosion, *Soil conservation, Soil properties, Rill erosion, Calcium, Organic matter, Soil erodibility.

Soil losses from crop row sideslopes were evaluated for 18 soils in a bare, tilled condition to determine their relative susceptibilities to interrill erosion. Erodibilities varied by a ratio of $> 10{:}1$ for the initial run and by 4:1 for succeeding runs. The poorly aggregated high-silt soils were most erodible, and the high-clay soils were least erodible. Simple correlations of interrill erosion with various soil properties were determined. Erosion was best correlated with clay (< 2 micro m) percentage, 1500 kPa water, exchangeable calcium, sum of exchangeable bases, cation exchange capacity, and organic matter content, all negatively. Interrill erosion was well correlated (positively) with the site specific K-factor of the universal soil loss equation. (Author's abstract)
W85-02876

**SEDIMENTS OF HANEJI INLET AND ITS ENVIRONS, OKINAWA, SUBTROPICAL JAPAN,**
University of the Ryukyus, Naha (Japan). Dept. of Marine Sciences.
H. Ujiie, and K. Nagano.
Galaxea, Vol. 3, No. 1, p 81-95, June, 1984. 9 Fig, 13 Ref.

Descriptors: *Sediments, *Bays, *Haneji Inlet, *Okinawa, *Japan, Subtropic zone, Geology, Erosion, Tidal effects.

A combination of the Emergy-settling tube and pipette methods was used to study the sediments at 43 stations in Haneji Inlet, a closed embayment, and surrounding seas. The composition analysis was used under microscope for the sand fraction and the ignition-loss analysis for the mud fraction. The sediments have some characteristics which well reflect their geological and geographical environments. A large amount of terrigenous materials has remarkably been trapped in the Inlet as sand and mud fractions. This may be caused by the geology of the southern hinterland which is susceptible to erosion and probably by such a hydrology as separated from open sea circulation. Some portions of the materials seem to be carried away during the ebb tide from the Inlet through a meandered, narrow and rather deep channel, where the sediments show intermediate features, not only in grain-size distribution but also in composition of sand and mud fractions, between those of the inside and outside of Haneji Inlet. Another prominent sedimentological aspect observed in the Inlet is an abundance of fecal pellets probably produced by anelid worms. The pellet-rich sediments contain distinctly more organic matter than those recognized in the other embayments of Okinawa. (Baker-IVI)
W85-02880

**SEDIMENT TRAP STUDIES IN LAKE MICHIGAN: RESUSPENSION AND CHEMICAL FLUXES IN THE SOUTHERN BASIN,**
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
B. J. Eadie, R. L. Chambers, W. S. Gardner, and G. L. Bell.
Journal of Great Lakes Research, Vol. 10, No. 3, p 307-321, 1984. 15 Fig, 3 Tab, 46 Ref.

Descriptors: *Lake Michigan, *Suspended solids, *Sediments, *Great Lakes, *Water analysis, Chemical analysis, Lake sediments, Minerals, Lakes, Resuspension, Phosphorus, Carbon cycle.

Sediment trap sample collections were carried on in the southeastern region of Lake Michigan for 4 years from 1977 to 1980. Findings are compared with water column and sediment characteristics. Mass flux data indicate strong seasonal patterns, with maximum fluxes recorded during the unstratified period. The large amount of winter resuspension is a mechanism which provides an intimate coupling of recent sediments and the water column. Also these trap study results indicate that there is a near-bottom benthic nepheloid layer whose chemical composition approaches that of deep water sediments. The amount of resuspended NaOH extractable phosphorus injected into the euphotic zone is estimated as approximately equal to the load of new phosphorus entering southern Lake Michigan. For both phosphorus and carbon, reintroduction of sediment bound material into the upper water column during winter by resuspension could play a significant part in the long term behavior of these and associated compounds. (Baker-IVI)
W85-02892

**SEDIMENTATION OF POLYCHLORINATED BIPHENYLS (PCBS) IN LIMNIC AND MARINE ENVIRONMENTS,**
Lund Univ. (Sweden). Limnological Inst.
For primary bibliographic entry see Field 5B.
W85-02911

**INCIPIENT MOTION OF SEDIMENT PARTICLES OVER FIXED BEDS,**
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
P. Novak, and C. Nalluri.
Journal of Hydraulic Research, Vol. 22, No. 3, p 181-197, 1984. 12 Fig, 2 Tab, 6 Ref.

Descriptors: *Sediment, *Fixed beds, *Smooth beds, *Rough beds, Channels, Froude numbers, Velocity, Shear stress, Sewer systems, Particulate matter, Particle size, Design criteria.

The paper analyses experimental data on incipient motion of single and grouped sediment particles in flumes with fixed smooth or rough beds with roughness smaller than the particle size. The results are represented as far as possible in dimensionless plots and equations applicable within the experimental range. A comparison with corresponding results for movable sediments beds (of

uniform grain size) enables a realistic assessment of the influence of the channel bed condition on the critical values of velocities, shear stresses and particle Froude numbers. The second part of the paper discusses the implications of the conclusions reached in this analysis on sewer design. It shows conclusively that for smaller diameters (less than 500 mm) the traditional method of computing slopes required for self-cleansing velocities gives higher values than required for initiation (and continuation) of movement of inorganic particulate matter. (Author's abstract)
W85-02931

**EROSION OF COHESIVE SOILS,**
Auckland Univ. (New Zealand).
A. J. Raudkivi, and S. K. Tan.
Journal of Hydraulic Research, Vol. 22, No. 4, p 217-233. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Erosion, *Clays, *Cohesive soils, Model studies, Hydrogen ion concentration, Geochemistry.

Experiments on erosion of cohesive soils using a circular couette flow erosion device and three clays with eight electrolytes (solutions) at approximately constant temperature are described. The analysis of the experimental results using the erosion model based on the rate process concept shows that the erosion rate of a clay by an electrolyte with different pH-values and molar salt concentrations can be explained by the orientation of the clay aggregates in the slurries before consolidation as well as predicted. The features of the eroded clay surfaces depend on the nature of the clay. The eroded surfaces of stiffer clays look in scanning microscope pictures distinctly pitted, whereas surfaces of clays with face to face stacking appear to flake. The eroded surfaces of soft clays show moulded features and undulating surface forms. However, most of the clays are neither stacked face to face nor soft, and they show an intermediate form of eroded surface features. Except for very soft clay, the surface of the eroded clay is distinctly pitted, in keeping with the picture that clay lumps have been lifted out of the surface. (Author's abstract)
W85-02953

**BOTTOM-BOUNDARY CONDITION FOR NONEQUILIBRIUM TRANSPORT OF SEDIMENT,**
Duke Univ., Durham, NC. Dept. of Mechanical Engineering and Materials Science
K. J. Cheng.
Journal of Geophysical Research, Vol. 89, No. C5, p 8209-8214, September, 1984. 6 Fig, 2 Tab, 10 Ref, 1 Append.

Descriptors: *Bottom-boundary conditions, *Boundary conditions, *Sediment transport, Sediment distribution, Mathematical equations, Model studies.

This paper formulates a generalized bottom-boundary condition for nonequilibrium transport of sediment in terms of two parameters: the deposition velocity and the equilibrium bottom concentration. Theoretical expressions for the two parameters are derived. Analytical solution to the sediment transport equation, using the generalized bottom-boundary condition, is also given. Finally, a number of available formulations of the bottom condition are reviewed and shown to be special cases of this generalized one. (Author's abstract)
W85-02962

**DUAL RADIOTRACER MEASUREMENT OF ZOOBENTHOS-MEDIATED SOLUTE AND PARTICLE TRANSPORT IN FRESHWATER SEDIMENTS,**
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. R. Krezoski, J. A. Robbins, and D. S. White.
Journal of Geophysical Research, Vol. 89, No. B9, p 7937-7947, September, 1984. 6 Fig, 2 Tab, 47 Ref. NSF grant OCE 7825680.

Descriptors: *Radioactive tracers, *Solute transport, *Particle transport, *Lake sediments, *Benthic animals, Oligochaetes, Crustaceans, Cesium radioisotopes, Sodium radioisotopes, Benthic environment, Sediment reworking, Burrowing, Feeding.

Gamma spectroscopy methods have been applied to determine the effects of Stylodrilus heringianus and Pontoporeia hoyi, two freshwater benthic macroinvertebrates, on reworking of sediments and the transfer of solutes across the sediment-water interface. Natural lake sediments (sieved to remove organisms) and overlying water were contained in temperature-regulated rectangular plastic cells. A submillimeter layer of sediment solids labeled with Cs-137 was deposited on the sediment interface while overlying water was spiked with Na-22. After addition of Stylodrilus (oligochaete worms) and Pontoporeia (crustacean amphipods) to these microcosms, the vertical distribution of Cs-137 (a tracer of particle transport) and Na-22 (a tracer of solute transport) were determined at daily to weekly intervals for 3 months by scanning the length of the cells with a well-collimated NaI detector. In cells with Stylodrilus, the Cs-137 layer moved downward at a rate that decreased exponentially with time. The displacement of the layer is the result of the conveyor-belt feeding mode of this organism. The rate of marked layer burial is consistent with that of other freshwater annelids (0.0000018 cm/d/individual/sq m; 11.6 C). The exponential decrease in burial rate is ascribed to uniformly distributed feeding of Stylodrilus within the feeding zone of 4.4 cm. In cells with Pontoporeia, Cs-137 activity was smeared downward in time owing to eddy diffusive mixing of sediments over a small range (1-2 cm). In cells without worms, the veneer of Cs active material remained at the interface while the penetration of Na-22 into sediments was consistent with diffusion in free solution with small corrections for sediment porosity and sorption (KD = 0.17). The effective diffusion coefficient De for Na-22 in this cell (0.0000082 sq cm/s) was essentially the same as that for a cell that had been inhabited by worms for 3 weeks and then poisoned with formalin just before addition of Na-22. Thus the presence of biogenically reworked sediments (with pelletized material and remnant burrow structures) did not affect solute transport. In cells with live Stylodrilus, penetration of Na-22 within the feeding zone was considerably more rapid, implying an apparent De twice as high as in cells without worms. Inferences based on the particle reworking results were used to develop an illustrative transport model that includes advective as well as diffusive terms. Advective transport arises from the incorporation of Na-22 into pore fluids moved downward as a result of conveyor-belt feeding. The model indicates that within the feeding zone, solute transport is dominated by advection and that the apparent enhancement of De in pure diffusion models is really the result of solute flow induced by particle reworking. In cells with Pontoporeia, De is approximately twice that in control cells. In these cells, Na-22 profiles may be treated theoretically without advection. (Author's abstract)
W85-02964

**INFLUENCES OF INCREASED SAND DELIVERY ON THE MORPHOLOGY OF SAND AND GRAVEL CHANNELS,**
Bureau of Land Management, Denver, CO.
W. L. Jackson, and R. L. Beschta.
Water Resources Bulletin, Vol. 20, No. 4, p 527-533, August, 1984. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Particle size, *Sand, *Gravel, *Channel morphology, Riffles, Bed load, Sediment transport, Scour, Roughness, Sedimentation.

A flume study was conducted to examine (1) changes in the particle-size distribution of sediments in riffles due to the proportion of sand in transport and the total rate of bedload transport at the time the riffle is deposited and (2) the effect of high sand transport rates on the stability of gravel riffles. The median particle size of sediment deposited in the riffle was larger than that of the sediment in transport. Small but significant (alpha = 0.05) decreases in the median particle size of riffle sediments resulted as the sand-to-gravel ratio of sediment in transport varied from 1:1 to 5:1. Gravel deposition efficiency decreased linearly as a function of the sand-to-gravel ratio. Increased concentrations of sand in transport caused previously stable gravel riffles to undergo scour. These results, in combination with information from other studies, suggest that an alluvial channel with pool-riffle sequences and with sand and gravel beds respond to an increased delivery of sand by reducing form roughness. Form roughness can be reduced be degrading riffles and filling pools. Subsequent responses may be increased in width-to-depth ratio and slope. (Author's abstract)
W85-02979

**SEDIMENT TRANSPORT, PART I: BED LOAD TRANSPORT,**
Waterloopkundig Lab., Delft (Netherlands).
L. C. van Rijn.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1431-1456, October, 1984. 12 Fig, 2 Tab, 46 Ref, 1 Append.

Descriptors: *Bed load, *Sediment transport, Saltation, Velocity, Particle motion, Mathematical models, Gravel.

A method is presented which enables the computation of the bed-load transport as the product of the saltation height, the particle velocity and the bed-load concentration. The equations of motions for a solitary particle are solved numerically to determine the saltation height and particle velocity. Experiments with gravel particles (transported as bed load) are selected to calibrate the mathematical model using the lift coefficient as a free parameter. The model is used to compute the saltation heights and lengths for a range of flow conditions. The computational results are used to determine simple relationships for the saltation characteristics. Measured transport rates of the bed load are used to compute the sediment concentration in the bed-load layer. A simple expression specifying the bed-load concentration as a function of the flow and sediment conditions is proposed. A verification analysis using about 600 (alternative) data shows that about 77% of the predicted bed load-transport rates are within 0.5 and 2 times the observed values. (Author's abstract)
W85-03011

**UNIFIED CULVERT SCOUR DETERMINATION,**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-03013

**FORMATION OF RIPPLES ON AN ERODIBLE BED,**
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
B. M. Sumer, and M. Bakioglu.
Journal of Fluid Mechanics, Vol. 144, p 177-190, July, 1984. 7 Fig, 23 Ref.

Descriptors: *Ripples, *Erosion, *Linear stability analysis, Reynolds number, Hydraulic engineering, Fluid mechanics, Flow, Streamflow, Stream bed, Bed load.

A linear stability analysis is presented of both hydraulically smooth and transitional flows over an erodible bed. The present theory is developed to account for the formation of ripples. The theory takes into consideration that the formation of ripples does not depend on flow depths, and that only the bed-load transport is involved in the formation of ripples. The effect of gravity is included in this analysis through the local inclination of the wavy bed surface. Results of the analysis show that an erodible bed will be unstable (and thus ripples will exist) when the grain Reynolds number is less than a certain value. The results appear to depend on the parameter beta, the effect of the combined action of the gravity and the local bed slope upon the bed-load transport. Ripple length appears to increase with grain size. The limiting values of the grain Reynolds number for ripple existence ob-

tained through present analysis were found to be in good agreement with observations. (Baker-IVI)
W85-03034

**BED LOAD TRANSPORT IN A RIVER MEANDER,**
California Univ., Berkeley. Dept. of Geology and Geophysics.
W. E. Dietrich, and J. D. Smith.
Water Resources Research, Vol. 20, No. 10, p 1355-1380, October, 1984. 26 Fig, 3 Tab, 44 Ref.

Descriptors: *Muddy Creek, *Wyoming, *Meanders, *Rivers, *Sediment transport, Bed load, Sedimentation.

Bed load transport in Muddy Creek, Wyoming, a sand-bedded meandering river with equilibrium bottom topography, consisted of a zone of maximum sediment flux that shifted across the channel from near the inside bank in the upstream part of the bend toward the pool at the minimum radius of curvature. This analysis of sediment transport indicated that a relatively small ratio of cross-stream to downstream transport will allow the zone of high bedload transport to follow the outward shifting zone of high boundary shear stress. Such a small ratio is difficult to measure or to compute from theory accurately. In large streams or in channels with high concentrations of suspended sediment that obscure the bed, it may be that the only way to compute the sediment transport vector through a given reach is to collect a large number of samples at selected positions across several closely spaced cross sections and then to compute the cross-stream sediment transport component using the equation for conservation of sediment mass. In the Muddy Creek study the oblique bed forms on the inside top of the point bar thin and die out where the zone of maximum boundary shear crosses from the inside bank toward the pool. The downstream increasing boundary shear stress over the pool causes the bed forms there to rotate. Coarse particles cross into the outward shifting zone of maximum boundary shear stress, and the fine particles are carried inward into the region of decreasing boundary shear stress. The zone of maximum bed load transport followed the outward shifting maximum boundary shear stress, leading to point bar equilibrium. Only at the downstream end of a bend, where the boundary shear stress field might not vary in the downstream direction, will a particle force balance that assumes no net cross-section transport apply. (Baker-IVI)
W85-03161

**EVALUATION OF METHODS FOR CALCULATING THE CONCENTRATION OF SUSPENDED BED MATERIAL IN RIVERS,**
Delaware Univ., Newark. Dept. of Geology.
J. E. Pizzuto.
Water Resources Research, Vol. 20, No. 10, p 1381-1389, October, 1984. 8 Fig, 2 Tab, 26 Ref.

Descriptors: *Suspended sediments, *River beds, *Sedimentation, *Mathematical equations, Sediment transport, Prediction, Rivers, Canals.

A modified Rouse equation is used to predict the average concentration of suspended bed material in rivers and canals with sandy, dune-covered beds. Equations of Einstein, Itakura and Kishi, and Engelund and Fredsoe are used to calculate the absolute concentration near the bed. The Itakura and Kishi equation gives the best results. The median concentration predicted with the Itakura and Kishi equation is about 50% greater than the observed concentration, and the errors vary within a relatively moderate range. Two empirical results were also obtained. A constant value of the absolute concentration equal to 22,258 ppm by weight, when substituted into the Rouse equation, gives better results than any of the theoretical equations. A simple regression equation is the most accurate of the methods discussed here. This suggests that, at present, empirical methods are superior to theoretical equations for practical determinations of suspended sediment concentrations. Current theories for the absolute concentration near the bed are incapable of accurately predicting trends observed in the field. Further study is needed to develop accurate models of sediment suspension for natural streams with sandy, dune-covered beds. (Baker-IVI)
W85-03162

**STREAM-BED ARMOURING UNDER KNOWN CONDITIONS OF UPSTREAM SEDIMENT INPUT,**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller, and A. C. Rowney.
Canadian Journal of Earth Sciences, Vol. 21, No. 9, p 1061-1066, September, 1984. 11 Fig, 3 Tab, 8 Ref.

Descriptors: *Armoring, *Sediment transport, *Stream beds, Sedimentation, Alluvial channels, Stability, Sediment load.

Experiments were conducted to assess ways in which an imposed sediment load can affect the formation and final nature of an armored bed. A flume loaded with a quartz aggregate of known composition was subjected to various sediment laden flows of water to produce armored beds. Characteristic parameters of the armored beds were then compared. Loads of sediment imposed on an armored bed by upstream sources can materially alter the final nature of the armored bed. This process appears to be the result of a complex interaction between original bed material and input feed sediment under the action of the flowing water. As the imposed sediment increased in particle size, the resulting grain roughness, amount eroded from the bed, and effective roughness of the bed all decreased. The mechanism by which the above trends occur is related to the motion of the upstream load in the flowing stream and is specifically related to the resulting bed forms and turbulent flow patterns. Even when specific bed forms were not created, moving sand grains apparently influenced formation of the armored layer. (Baker-IVI)
W85-03197

**INTERPRETATION OF GRAIN-SIZE DISTRIBUTIONS FROM MEASURED SEDIMENT DATA, PLATTE RIVER, NEBRASKA,**
Geological Survey, Denver, CO. Water Resources Div.
T. R. Eschner, and J. E. Kircher.
Sedimentology, Vol. 31, No. 4, p 569-573, August, 1984. 4 Fig, 9 Ref.

Descritors: *Sedimentation, *Particle size, *Platte River, *Nebraska, *River sediments, Bed load, Suspended sediments, Discharge frequency, Suspended solids, Flow discharge.

Breaks in the slope of log-probability plots of cumulative grain-size distributions of bed material are compared with frequency distributions of bedload and suspended sediment over a range of discharges at two stations on the Platte River in south-central Nebraska. The break between suspension and intermittent suspension as determined from the bed material curve coincides with the upper limit of the grain size overlap between bedload particles and suspended sediment particles, whereas the break between intermittent suspension and traction corresponds to the grain size at the lower limit of overlap of bedload particles and suspended sediment particles. Discharge has little effect on the size distribution of bedload, but it has a significant effect on the size distribution of suspended sediment. With increasing discharge, the percentage-finer value of a suspended sediment sample associated with a given grain size decreases. Thus, the overlap of the bedload and the suspended-sediment distributions lengthens as the coarsest grains in suspension increase in size with increasing discharge. (Baker-IVI)
W85-03214

**FACIES MODEL FOR A SANDY EPHEMERAL STREAM AND CLAY PLAYA COMPLEX: THE MIDDLE DEVONIAN TRENTISHOE FORMATION OF NORTH DEVON, U.K.,**
Plymouth Polytechnic (England). Geology Div.
I. P. Tunbridge.
Sedimentology, Vol. 31, No. 5, p 697-715, October, 1984. 18 Fig, 2 Tab, 78 Ref.

Descriptors: *Model studies, *Sedimentation, *Ephemeral streams, *Hangman Sandstone Group, *Trentishoe Formation, *Playas, Clay, Sandstone, Floods, Sand, Sediments, Alluvial plains.

A model is developed for sandy ephemeral stream and clay playa deposition using sediments in the Trentishoe Formation of the Middle Devonian Hangman Sandstone Group as the basis. Three types of sequence are found, representing proximal, medial and distal areas on an extensive alluvial plain. Cross-cutting channel-fill sandstones compose the proximal sequence, representing the deposits of a network of low sinuosity sand bed streams. Upwards coarsening cyclothems which start with relatively distal, thinly bedded sandstone and siltstone flood sheets cut by complexes of silt draped channel-fill sandstones and single channel fill sandstones comprise the Medial sequence. The flood sheets coarsen and thicken upwards to more proximal multistorey sheet sandstones. Laminated mudstone and sandstone cut by desiccation and water escape features mark the Distal sequences. These escape features alternate with wave rippled sandstones, and represent playa lakes occasionally incised by high sinuosity channels with laterally accreting sandstones. The three sequence types represent the downslope progression from a low sinuosity channel network which passed into an ephemeral flood deposit complex which in turn drained into clay playa. (Baker-IVI)
W85-03215

**CONTROLS OF SEDIMENTATION IN THE MALAWI RIFT VALLEY, CENTRAL AFRICA,**
Malawi Univ., Zomba. Dept. of Geography.
R. Crossley.
Sedimentary Geology, Vol. 40, No. 1/3, p 33-50, July, 1984. 6 Fig, 15 Ref.

Descriptors: *Sedimentation, *Malawi Rift Valley, *Africa, *Lake Malawi, Topography, Climate, Rivers, Deltas, Phosphates, Minerals, Iron, River basins, Climate, Topography.

The Malawi Rift is the southernmost classic rift valley trough in the Cenozoic African Rift Valley System. Much of its floor is flooded by Lake Malawi which is about 570 km long, 60 km across and up to 500 m deep. This rift basin is a potentially useful analogue of many economically important ancient sedimentary troughs. The over-riding importance of the rift boundary structure in controlling sedimentation in the basin as a whole cannot be over emphasized. The tectonic topography of the rift escarpment zone is important in controlling the character of clastic inputs into the basin floor and the overall depth of the basin is also related to the type of rift boundary structure. The hydrology and climate of the Malawi Basin ensures that a substantial part of the basin is flooded and that thermal stratification of the lake occurs. The water balance of the Malawi Trough shows that accidents of basin location, in terms of how much pre-rift drainage network is captured, can be as important as climate in determining whether the basin becomes filled to an overflow level with fresh water, or whether it becomes floored by a smaller, enclosed, more saline depositional system. Climate is the dominant control on the hydrologic budget and at present the basin is flooded to overflow level. Prevailing winds are important in beach ridge and back-beach aeolian dune development. Climatic conditions produce thermal stratification of the lake, with an oxic epilimnion down to 250 m depth overlying an anoxic hypolimnion. The oxic bottom waters in the shallower parts of the lake appear to promote iron precipitation in the sediments. (Baker-IVI)
W85-03216

## 2K. Chemical Processes

**CHEMISTRY OF BULK PRECIPITATION AT A SITE IN SOUTHEAST ENGLAND - I. SMALL-SCALE SPATIAL VARIATION, FRE-**

QUENCY DISTRIBUTIONS AND VARIATION WITH TIME,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
R. A. Skeffington.
Atmospheric Environment, Vol. 18, No. 8, p 1683-1693, 1984. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Rainfall, *Seasonal variation, *England, Ammonium ion, Chloride, Deposition, Hydrogen, Nitrates, Organic matter, Sulfates, Spatial variation, Temporal variation.

A statistical analysis is offered of bulk precipitation chemistry data from rain falling on the Tillingbourne Catchment, Surrey, Southeast England in the years 1978-1981. Measurements of weekly average pH, organic content, sulfate, nitrate ammonium and chloride were made. There is some evidence for small-scale variation in precipitation chemistry. Some of the organic component was probably due to a local source. The more elevated rain sampler collected more rainfall and concentrations were no lower, confirming that deposition is governed by rainfall amount. Weekly precipitation pH was normally distributed with a few outliers at high pH. Other precipitation species were about log-normal distributed, but sulfate, and ammonium had more high values than expected and chloride was irregularly distributed. More deposition fell in a fairly small proportion of weeks. Both concentration and deposition vary substantially from month to month and from year to year. Most ions have late spring maxima in concentrations except of Cl(-) which had a winter maximum and FA where the peak extends into summer. The evidence suggests that these patterns are due to meteorological factors. The seasonal pattern in deposition is similar but not as strong. (Baker-IVI)
W85-02732

CHEMISTRY OF BULK PRECIPITATION AT A SITE IN SOUTHEAST ENGLAND - II. RELATIONSHIPS BETWEEN IONS AND COMPARISON WITH OTHER SITES,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
R. A. Skeffington.
Atmospheric Environment, Vol. 18, No. 8, p 1695-1704, 1984. 4 Fig, 7 Tab, 30 Ref.

Descriptors: *Rainfall, *Precipitation chemistry, *England, *Ions, Ammonium, Chlorides, Regression analysis, Hydrogen ion concentration, Sulfates, Nitrates.

A statistical analysis of bulk precipitation chemistry of rain falling on the Tillingbourne Catchment, Surrey, England is presented. The mean volume-weighted pH of precipitation over the years 1978-1981 was 4.15. This is at the low end of the range of other measuring sites in the United Kingdom. Concentrations of sulfates, nitrates, ammonium ions and chlorides were moderate compared to other United Kingdom sites. Seasonal patterns in ionic ratios are not pronounced. Ionic concentrations are highly correlated. The slope of the regression of H(+) vs NO3(-) is almost unity, which probably means that most of the nitrate anion is associated with nitric acid. Deposition is approximately related to rainfall by a power law relationship in which the exponent of the equation varies between 0.5 and 0.9. Both precipitation volume and concentration are required to estimate deposition adequately. (Baker-IVI)
W85-02733

CARBON AND HYDROGEN ISOTOPIC COMPOSITION OF BACTERIAL METHANE IN A SHALLOW FRESHWATER LAKE,
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W85-02786

DISSOLVED IODINE SPECIES IN A BRITISH FRESHWATER SYSTEM,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2H.
W85-02788

ORGANIC COMPLEXATION OF ZINC IN ESTUARINE INTERSTITIAL AND SURFACE WATER SAMPLES,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W85-02789

CARBON FLOW THROUGH OXYGEN AND SULFATE REDUCTION PATHWAYS IN SALT MARSH SEDIMENTS,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2L.
W85-02790

PARTICLE FLUX AND TRACE METAL RESIDENCE TIME IN NATURAL WATERS,
Lamont-Doherty Geological Observatory, Palisades, NY.
P. H. Santschi.
Limnology and Oceanography, Vol. 29, No. 5, p 1100-1108, September, 1984. 3 Fig, 2 Tab, 50 Ref. DOE grant DE-AC02-76-EV02185 and NSF grant DEB-80-17639.

Descriptors: *Trace metals, *Chemical composition, *Fluctuations, *Zinc, *Thorium, *Oceans, *Lakes, Nuclides, Seawater.

A simple inverse relationship between trace metal residence time and particle flux through the water column was tested on the trace metals Zn(2+) in freshwater and Th(IV) in ocean water systems with available data on the vertical flux and concentration of particulate matter and of Zn(2+) in lakes or on the disequilibrium of U/Th nuclides in the ocean. Even though a single-box model of trace metal removal from a body of water such as the ocean or a lake is an oversimplification, it appears that this approach together with a first-order removal process adequately represents the cycling of trace metals such as Th(IV) in the ocean and Zn(II) in lakes. The master variable in this case is the particle flux through the system, which regulates both concentration and residence times. (Baker-IVI)
W85-02792

DETERMINATION OF INORGANIC TELLURIUM SPECIES IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
M. O. Andreae.
Analytical Chemistry, Vol. 56, No. 12, p 2064-2066, October, 1984. 1 Fig, 1 Tab, 20 Ref. NSF grant OCE-8200931.

Descriptors: *Water analysis, *Tellurium, *Natural waters, Seawater, Chemical analysis, Natural waters, Spectrometry.

A combination of preconcentration and analytical procedures which allow the determination of Te(IV) and Te(VI) with Mg(OH)2 at concentrations typical of natural waters is presented. Te(IV) and Te(VI) are coprecipitated from natural waters, including seawater. Following redissolution of the precipitate with HCl, Te(IV) is reduced in 3 M HCl to tellurium hydride. The hydride is trapped inside the graphite tube of a graphite furnace atomic absorption spectrometer heated to 300 C, and then determined by atomization. Te(VI) is reduced to Te(IV) by boiling with HCl and then determined as Te(IV). The limit of detection is 0.5 pmol/L and the precision is 10-20%. (Baker-IVI)
W85-02831

ION CHROMATOGRAPHIC DETERMINATION OF NITRATE AND SULFATE IN NATURAL WATERS CONTAINING HUMIC SUBSTANCES,
Lund Univ. (Sweden). Dept. of Analytical Chemistry.
G. Marko-Varga, I. Csiky, and J. A. Jonsson.
Analytical Chemistry, Vol. 56, No. 12, p 2066-2069, October, 1984. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Water analysis, *Nitrates, *Sulfates, *Natural waters, *Humic acids, Chromatography, Monitoring.

In the study of the pollution of natural waters, the concentrations of nitrate and sulfate are important factors. The analytical methods use for nitrates and sulfates are to varying extents influenced by the presence of humic substances in natural waters. Determinations of anions in natural waters by various methods, including ion chromatography, are disturbed by the inevitable presence of humic substances. A cleanup column, packed with chemically bonded amine material for HPLC, is useful for the selective removal of disturbing humic substances prior to anion analysis by ion chromatography. For all the development work described, the same separation column is used. No change was noted in color of the resin nor any deterioration of the chromatographic properties after more than 500 injections and thus it was concluded that the separation column was effectively protected from the disturbing fraction of humic acid. A technique similar to the one described probably can be used to discriminate metal ions associated with humic substances from free metal ions. (Baker-IVI)
W85-02832

MAJOR ION AND CARBONATE SYSTEM CHEMISTRY OF A NAVIGABLE FRESHWATER CANAL,
Liverpool Univ. (England). Dept. of Inorganic, Physical and Industrial Chemistry.
For primary bibliographic entry see Field 5B.
W85-02841

CONCENTRATIONS AND ANNUAL LOADING OF DISSOLVED ORGANIC MATTER IN A SMALL MOORLAND STREAM,
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W85-02842

ACID PRECIPITATION IN THE COLORADO FRONT RANGE: AN OVERVIEW WITH TIME PREDICTIONS FOR SIGNIFICANT EFFECTS,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
G. W. Kling, and M. C. Grant.
Arctic and Alpine Research, Vol. 16, No. 3, p 321-329, August, 1984. 5 Fig, 4 Tab, 76 Refs.

Descriptors: *Colorado Front Range, *Rocky Mountains, *Acid precipitation, *Ecological effects, Lakes, Streams, Alpine regions, Mountains, Model studies.

The sensitivity of both aquatic and terrestrial systems to acid precipitation is determined by the dynamic interaction of pedology, vegetation, geology, and climate. By evaluating these variables, first-level assessments were made regarding the sensitivity of Colorado Front Range to the effects of increasing acicity in precipitation. Natural features in the Colorado Front Range interact to form a region that is potentially sensitive to acid precipitation. Regression analysis on historical data from 88 lakes and streams showed significant ($p < 0.001$) decreasing pH and alkalinity trends with increasing elevation. A similar significant ($p < 0.008$) decreasing trend as elevation increases was found for soil pH and base saturation. The greatest proportion of change in acid input and buffering capacity in this western region has probably occured in the last 10 years. Considering both soil and water chemistry, regions above 3300 m (alpine) were the most sensitive to continued inputs of acidic materials. If current acid loading rates remain constant, strong potential exists for buffering losses in surface waters, increases in soil acidification, and adverse effects on biota. A model using reported rates of decline in buffering capacities of Front Range lakes suggests that these changes are likely to become important in a matter of decades. If acid deposition rates increase, buffering capacity losses in lakes and streams will sooner reach the

threshold where adverse biological changes will occur. (Collier-IVI)
W85-02856

**VARIATION OF CALCIUM, MAGNESIUM, SODIUM AND POTASSIUM CONCENTRATION, PH AND CONDUCTIVITY IN LAKES IN NORTHERN IRELAND,**
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
For primary bibliographic entry see Field 2H.
W85-02894

**INTERACTION OF CLAYS WITH DILUTE FLUORIDE SOLUTIONS,**
Newcastle Univ. (Australia). Dept. of Chemistry.
J. Slavek, H. Farrah, and W. F. Pickering.
Water, Air, and Soil Pollution, Vol. 23, No. 2, p 209-220, August, 1984. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Clays, *Fluorides, *Fate of pollutants, Hydrogen ion concentration, Sodium fluoride, Kaolinite, Illite, Montmorillonite, Aluminum, Adsorption.

Interaction between dilute (mg/L) NaF solutions and clay suspensions (0.08% w/v) has been examined as a function of pH (range 3 to 8), clay type (Na(+)- or Ca(2+)-kaolinite, illiite, montmorillonite) and NaF concentration. No F loss from solution was detected at pH $>$ 6.5, while enhanced uptake was found on decreasing the pH, especially in the 4 to 3 region. Removal of F from 0.0001 to 0.0006 M NaF was only slightly dependent on weight of solid, but did increase with concentration of F(-). It is proposed that F losses are due to the formation of sparingly soluble Al species (e.g. cryolite, Na fluoro silicate), occasionally augumented with CaF2 formation (Ca(2+)-clays). The Al is released by proton attack on the lattice, following conversion of the suspended solids into the unstable H(+)-form, either through acid addition (pH $<$ 5) or through hydrolysis of the Na(+)-form material. The latter process was most pronounced with the illite and montmorillonite samples. The amount of F fixed by montmorillonite was roughly double that held by the other two clays, and had maximum value (pH 3) of approximately 4 mg/g, using 11 mg/L NaF solutions. Soluble fluoro-complexes, similar in quantity to the retained F, were detected, in many of the studies. It was concluded that contact of the clay components of soils or sediments with mg/L levels of F in adjacent aqueous phases would result in only a minor proportion being retained. (Author's abstract)
W85-02928

**PHOTOREDUCTIVE DISSOLUTION OF COLLOIDAL IRON OXIDES IN NATURAL WATERS,**
Massachusetts Inst. of Tech., Cambridge.
T. D. Waite, and F. M. M. Morel.
Environmental Science and Technology, Vol. 18, No. 11, p 860-868, November, 1984. 11 Fig, 2 Tab, 39 Ref. NSF grant OCE-8119103 and NOAA grant NS79AA-D-00077.

Descriptors: *Photochemical reactions, *Iron oxides, *Dissolution, *Natural waters, Chromophores, Colloids, Organic matter, Photoreduction, Irradiation, Hydrogen peroxide, Hydrogen ion concentration.

Size-separation (0.1 micro m filtration and ultrafiltration) techniques and coulometric procedures have been used to investigate the photoreductive dissolution of iron oxides under conditions typical of natural waters. In the absence of organic agents, iron oxides are solubilized to varying degrees through photodissociation of ferric hydroxy groups at the colloid surface. The degree of dissolution is dependent principally on the chromophore concentration and is highest at low pH and high colloidal surface area. Naturally occurring organic materials significantly increase the initial rate of dissolution. Despite the enhancement by organic agents significant effects of light on net dissolution are only observed at low pH. Irradiation of natural waters produces hydrogen peroxide in quantities sufficient to markedly affect the solution-phase speciation of iron and under certain conditions (e.g., seawater) also affects the net photodissolution of iron oxides. (Author's abstract)
W85-03057

**ACTYLENE REDUCTION AND NITROGEN FIXATION POTENTIAL IN SOME EUTROPHIC LAKE SEDIMENTS,**
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
L. Mackenzie.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 2, p 241-249, July, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Nitrogen fixation, *Acetylene reduction, *Eutrophic lakes, Lake sediments, Nutrients, Biomass, Microorganisms, Organic carbon.

The in situ acetylene-reducing (nitrogen-fixing) activities within the sediments of 2 eutrophic lakes were examined to determine whether this process plays a significant role in enhancing nutrient enrichment of these lakes. Estimates of the N-fixing potential on a sediment dry-weight basis were 10.9-112.1 ng/g/h or on an area basis were 45.3-99 ng/sq m/h. The distribution of C2H2 reducing activity within the sediment paralleled the distribution of Kjeldahl N, total organic carbon, and microbial biomass and was inversely related to NH4(+)-N in interstitial water. A seasonal variation in the activity was observed in the top most sediment strata, with the highest rates occurring during winter. Estimates of the total N input reveal that this is of little quantitative importance compared to inputs of combined N from other sources. (Author's abstract)
W85-03075

**HYDROCHEMICAL BUDGETS FOR A MAGNESIAN LIMESTONE CATCHMENT IN LOWLAND ENGLAND,**
Birmingham Univ. (England). Dept. of Civil Engineering.
R. W. Crabtree, and S. T. Trudgill.
Journal of Hydrology, Vol. 74, No. 1/2, p 67-79, October, 1984. 2 Fig, 7 Tab, 22 Ref.

Descriptors: *Hydrochemistry, *Magnesian Limestone, *England, *Solution budget, Solutes, Weathering, Groundwater, Calcium, Magnesium, Water pollution effects, Acid rain, Percolation, Springs, Piston flow, Matrix seepage.

A solute budget study was conducted on a Magnesian Limestone catchment in lowland eastern England for a year from June 1, 1979 to June 1, 1980. Of the total solute output from the catchment, 66% was derived from chemical weathering. This was equivalent to the removal of 778.1 kg/ha/yr in solution. Solutional denudation losses of Ca(2+) and Mg(2+) were 180 and 101 kg/ha/yr, with a Ca(2+)/Mg(2+) ratio of 0.57. The total input of material from atmospheric sources into the catchment was 400.5 kg/ha/yr. The high input is assumed to be the result of air pollution by nearby industries, a higher rainfall and wind-blown soil and quarry dust. The major solutes species produced were Ca(2+), Mg(2+) and HCO(-3), derived mainly from chemical weathering by percolating acidic rain water. Catchment runoff was comprised of combined piston flow in fissures to springs and matrix seepage. Solute levels are lower in spring than wells, but Ca(2+)/Mg(2+) ratios overlap for the two flow types. Springs have a rapid response to rainfall events, without any dilution of solute concentrations. The wells all showed a slight seasonal response, which was more evident in the springs. (Moore-IVI)
W85-03083

**SIMULATION OF NITROGEN DYNAMICS IN FLOODED SOILS,**
Florida Univ., Gainesville. Dept. of Soil Science.
P. S. C. Rao, R. E. Jessup, and K. R. Reddy.
Soil Science, Vol. 138, No. 1, p 54-62, July, 1984. 8 Fig, 6 Tab, 26 Ref.

Descriptors: *Flooded soils, *Nitrogen cycle, *Simulation, Fertilizers, Denitrification, Volatilization, Nitrification, Hydrogen ion concentration, Nitrates, Ammonia, Flooding.

A simulation model, NFLOOD, was developed for describing simultaneous partitioning, transformations, and transport of nitrogen in flooded soils. Selected cases were simulated using NFLOOD to identify the relative gaseous losses of soil and fertilizer N via denitrification and NH3 volatilization. Model simulations identified the factors controlling gaseous N losses to be: the rate of NH4(+) and NO3(-) diffusion from or into the soil; nitrification (NH4(+) to NO3(-)) rate in the floodwater and the soil; the magnitude of diel variations in floodwater pH, and the method of fertilizer N application. Addition of fertilizer N to floodwater rather than to soil results in greater gaseous losses of N. NH3 volatilization losses are important only with significant diel variations in floodwater pH and when nitrification rate is small, and denitrification losses are directly related to rate of nitrification in the floodwater and the oxidized soil layer. In this model, NH4(+) and NO3(-) uptake by plants from the floodwater and from the soil were not considered. Denitrification losses may be greater, and volatilization losses may be smaller than those simulated at present. (Moore-IVI)
W85-03092

**AMMONIUM ION, HUMIC MATERIALS, AND TRIHALOMETHANE POTENTIAL IN NORTHEASTERN KANSAS GROUND WATERS,**
Kansas State Geological Survey, Lawrence.
J. E. Denne, L. R. Hathaway, and S. P. McCool.
Groundwater, Vol. 22, No. 6, p 755-763, November-December, 1984. 5 Fig, 4 Tab, 26 Ref.

Descriptors: *Glacial aquifers, *Groundwater pollution, *Kansas, Humic acids, Ammonium, Nitrates, Trihalomethanes, Aquifers.

Glacial buried-valley aquifers serve as primary sources of potable groundwater in northeastern Kansas. Potential problems associated with nitrates, ammonium, and organic material do exist. In a large percentage of well waters in the region the nitrate level standard for drinking water is exceeded, but water from the deep buried valleys commonly has low nitrate levels and relatively high ammonium concentrations. The high dissolved ammonium concentrations seem to be associated with reducing conditions and relatively high levels of extractable ammonium in the glacial deposits, which range up to 75 mg/kg. The amounts generally increase downward from the topsoil, with highest values in the gray sediments and buried soils, materials often containing high contents of organic matter. A black floating scum observed on the fluid and sediments from numerous test holes drilled in the study area may be from buried humic materials. Chlorination of water containing humic material and other dissolved organics may lead to the production of chlororganic compounds including THMs. For two public-water supply wells, chlorinated samples quenched for one week yielded THM concentrations close to the maximum-contaminant level The THM production potential and the ammonium content of ground water from the glacial aquifers need further evaluation. The role of anaerobic bacteria in these aquifer systems might warrant consideration in relationship to the THM potential of the waters. In this hydrogeochemical environment, well siting and construction and disinfection procedures need careful review in order to minimize water quality hazards. (Baker-IVI)
W85-03155

**ISOTOPE GEOCHEMISTRY OF STRATIFIED LAKE 'A', ELLESMERE ISLAND, N.W.T., CANADA,**
Calgary Univ. (Alberta). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W85-03195

**WATER-ROCK INTERACTION AND CHEMISTRY OF GROUNDWATERS FROM THE CANADIAN SHIELD,**

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. K. Frape, P. Fritz, and R. H. McNutt.
Geochimica et Cosmochimica Acta, Vol. 48, p. 1617-1627, 1984. 6 Fig, 2 Tab, 36 Ref.

Descriptors: *Chemical composition, *Canadian Shield, *Groundwater, Geochemistry, Water analysis, Isotopes, Chlorides, Bromides, Salts, Dissolved solids, Saline water, Brines, Temperature effects.

The chemical and isotopic compositions of groundwaters in the crystalline rocks of the Canadian Shield reflect different degrees of rock-water interactions. The chemistry of the shallow, geochemically immature groundwaters and especially of the major cations is controlled by local rock compositions, whereby dissolution reactions dominate. Conservative constituents, such as chloride and bromide, are not entirely a result of such reactions but appear to be readily added from leachable salts during the initial stages of the geochemical evolution of these waters. Their concentration changes little as major cations increase, until concentrations of total dissolved solids reach 3000 to 5000 mg/l. The isotopic composition of these shallow waters reflects local, present day precipitations. Isotopic and chemical compositions of the deep, saline waters and brines are determined by extensive, low-temperature rock-water interactions. This is documented in major ion chemistries, oxygen contents and strontium isotopic compositions. These data indicate that the deep brines have been contained in hydrologically isolated pockets. The almost total loss of primary compositions makes discussion of the origin of these brines very speculative. All brines from across the Canadian Shield have a very similar chemical composition, which probably reflects a common geochemical history. The concentrations of some major and most minor elements in these fluids appear to be governed by reactions with secondary mineral assemblages. (Baker-IVI)
W85-03205

**INCORPORATION OF TRIVALENT CHROMIUM INTO RIVERINE AND ESTUARINE COLLOIDAL MATERIAL,**
Maine Univ. at Orono, Walpole. Dept. of Oceanography.
L. M. Mayer, L. L. Schick, and C. A. Chang.
Geochimica et Cosmochimica Acta, Vol. 48, No. 9, p 1717-1722, 1984. 6 Fig, 31 Ref.

Descriptors: *Chemical reactions, *Chromium, *Estuarine environment, Trace metals, Salinity, Seawater, Flocculation.

The binding of dissolved trivalent chromium by dissolved and colloidal substrates at the river-estuary interface was studied using a combination of product and reactant mode experiments, at concentrations of materials typical of estuarine conditions. Using spikes of 1-20 micro g/l Cr(3+), about one third of the Cr(3+) was scavenged by that fraction of riverine colloidal material which flocculated upon mixing of river water and seawater. Reactant mode experiments, using chemiluminescence as a speciation technique, showed that virtually all of the spiked Cr(3+) was bound by dissolved or colloidal substrates, but that the higher molecular weight fractions were able to kinetically out-compete the lower molecular weight fractions. Cr added to waters near a river estuary interface may apparently be bound within a few hours by dissolved or colloidal material present in the river water. On the order of a third of this scavenged material will be incorporated into the flocs that form as a result of destabilization of riverine colloidal material by seasalt, owing to the higher reactivity of the riverine colloidal material to Cr binding. The increase in salinity encountered during passage of the river water through the estuary will probably not kinetically inhibit this binding, nor will it have much effect on the partitioning of the Cr between flocculated and unflocculated substrates. (Baker-IVI)
W85-03206

**DESORPTION AND COAGULATION OF TRACE ELEMENTS DURING ESTUARINE MIXING,**
Lamont-Doherty Geological Observatory, Palisades, NY.
Y.-H. Li, L. Burkhardt, and H. Teraoka.
Geochimica et Cosmochimica Acta, Vo. 48, No. 9, p 1879-1884, October, 1984. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Trace elements, *Estuarine environment, *Desorption, *Coagulation, *Hudson River, *Mississippi River, Seawater, Suspended solids, Hydrogen ion concentration, Heavy metals.

Mixing experiments of seawater and the Hudson and Mississippi riverwaters with radiotracer spikes show that Co, Mn, Cs, Cd, Zn, and Ba will be desorbed from river suspended particles, while significant fractions of dissolved Fe, Sn, Bi, Ce, and Hg will be coagulated during estuarine mixing. The Kd's for Co, Mn, Cs, Cd, Zn, and Ba decrease with salinity, suggesting the desorption of these cations from the river suspended particles during estuarine mixing. The coagulation of the metal-humates of these cations are negligible during the estuarine mixing of the Hudson and Mississippi rivers. The increase of distribution coefficients (Kd's) for Fe, Sn and Bi, Ce and Hg with salinity suggests that a significant fraction of Fe, Sn, Bi, Ce and Hg coagulate during estuarine mixing. The Kd for Ir is independent of salinity and the Kd for Sb decreases only slightly with increasing salinity or pH. Both elements may exist as anions in natural aquatic environments. The decrease in Kd for Hg with slight increase in pH may indicate the existence of anionic Hg-organic matter complexes in natural aquatic environments. The extent of desorption of Co, Mn, Cs, Cd, Zn and Ba from suspended particles during estuarine mixing depends more on salinity than on pH changes. In a normal natural estuarine environment, the increase in both pH and sea salts and the existence of suspended particles all enhance the coagulation of metals with high hydrolysis constants such as Fe, Sn, Bi and rare earths. (Baker-IVI)
W85-03208

**MANGANESE CHEMISTRY IN RIVERS AND STREAMS,**
Edinburgh Univ. (Scotland). Dept. of Geology.
D. P. H. Laxen, W. Davison, and C. Woof.
Geochimica et Cosmochimica Acta, Vol. 48, No. 10, p 2197-2111, October, 1984. 4 Fig, 2 Tab, 33 Ref.

Descriptors: *Manganese, *Rivers, *Streams, *Chemistry, Chemical speciation, Chemical properties, Acidity, Specific conductance, Geochemistry, Particulates, Lakes.

The speciation of Mn in 15 rivers and streams representing a wide range of water types is examined. By collecting details of the geochemistry of these waters factors which play an important role in determining the speciation pattern may be discerned. Using the technique of anodic stripping voltammetry (asv), specific for reduced Mn(II) species, a major part of the <0.015 micro m Mn size fraction is found to be present in a reduced Mn(II), asv-labile, form. There is also a significant asv inactive Mn fraction found in some waters, considered to be present as a small colloidal species. The soluble Mn fraction represented 15-95% of the total Mn and does not appear to be dependent upon pH, alkalinity, conductance or humic substance concentration in the water. Under the dynamic, short residence time, conditions that apply in most rivers, the particulate and soluble Mn fractions are decoupled, their respective presence being dependent principally on the catchment hydrogeological conditions. Consideration of manganese speciation in waters which were incubated for five months showed that pH becomes the controlling factor when equilibrium is approached. Thus it appears in general that Mn chemistry in rivers and streams is dominated by the hydrogeological conditions in the catchment, rather than chemical processes within these water bodies. It is only when Mn enters lakes, estuaries and the ocean, where residence times are considerably longer, that chemical processes will become dominant and the system will approach an equilibrium speciation. (Baker-IVI)
W85-03213

## 2L. Estuaries

**NITROGEN-15 ISOTOPE DILUTION STUDY OF AMMONIUM PRODUCTION AND CONSUMPTION IN A MARSH SEDIMENT,**
Marine Biological Lab., Woods Hole, MA.
W. B. Bowden.
Limnology and Oceanography, Vol. 29, No. 5, p 1004-1015, September, 1984. 4 Fig, 5 Tab, 28 Ref. DEB grant 81-12090 and NFS grant OCE 78-0847.

Descriptors: *Marshes, *Ammonium, *Isotope studies, Sediments, Tidal marshes, Temperature effects, Microbial degradation, Massachusetts.

Isotope dilution experiments were performed using sediments from a tidal, freshwater marsh in Massachusetts. Ammonium production (rp) and consumption (rc) rates in these marsh sediments are controlled in large part by temperature and the quality and availability of organic substrates. High temperature and good substrate quality support high values for rp and rc, while low temperature and poor substrate quality restrict rp and rc. In general, the cumulative effect of these controlling variables is to restrict most ammonium production and consumption to the top 10-20 cm of sediment during the warm growing season of May-September. The mean gross rate of ammonium production for seven experiments run between September 1980 and December 1981 is about 11.6 nmol N/cu cm of fresh sediment/hr for 5-10 cm deep, mixed, emergent marsh sediments incubated at 13 C. For the same sediments, gross consumption excluding plant root uptake is about 6.4 nmol N/cu cm fresh sediment/hr. The findings show that mixing elevates ammonium production and consumption rats by up to 7 times and that the observed rates are constant for about 50 hr. Isotope dilution of ammonium is a good indicator of ammonium turnover in sediments but may be a poor indicator of total nitrogen turnover and, therefore, of total microbial activity. (Baker-IVI)
W85-02787

**ORGANIC COMPLEXATION OF ZINC IN ESTUARINE INTERSTITIAL AND SURFACE WATER SAMPLES,**
Liverpool Univ. (England). Dept. of Oceanography.
C. M. G. van den Berg, and S. Bharmvanij.
Limnology and Oceanography, Vol. 29, No.5, p 1025-1036, September, 1984. 6 Fig, 4 Tab, 34 Ref.

Descriptors: *Estuaries, *Zinc, *Surface waters, *Metal complexes, River Mersey, River Dee, River Ribble, England, Gulf of Thailand, Heavy metals, Estuarine environment, Chemical reactions, Salinity.

The organic complexing capacity for zinc in natural water samples was determined by equilibration of added Zn-65 with manganese dioxide. Stability constants for complexes with EDTA and NTA in seawater were determined in preliminary tests. Samples were collected from interstitial waters in surficial sediments from the upper Gulf of Thailand and the estuary of the River Mersey in England and from surface water from the estuaries of the Rivers Dee and Ribble in England. Complexing capacities for zinc of between 0.02 and .000002 M were observed in the surface water. Values for conditional stability constants ranged from 7.4 to 9.3 and decreased with increasing salinity. Between 93 and 98% of zinc is complexed by organic material in most interstitial water samples as a result of higher ligand concentrations, much less in surface waters. This finding indicates that the dissolved zinc concentration may well increase as a result of competition by dissolved ligands for zinc adsorbed on sedimentary particles. Such a process of remobilization of adsorbed zinc as a result of ligand production by bacterial or algal decay, may explain the increased metal concentrations in waters near sediments or in shallow waters. (Baker-IVI)
W85-02789

**CARBON FLOW THROUGH OXYGEN AND SULFATE REDUCTION PATHWAYS IN SALT MARSH SEDIMENTS,**
Woods Hole Oceanographic Institution, MA.
B. L. Howes, J. W. H. Dacey, and G. M. King.
Limnology and Oceanography, Vol. 29, No. 5, p 1037-1051, September, 1984. 7 Fig, 54 Ref. NSF grants BSR7905127, BSR8021741, BSR8104701, and NSF EPSCOR.

Descriptors: *Salt marshes, *Sediments, *Oxygen uptake, Sulfates, Chemical reactions, Seasonal variation, Salinity, Interstitial water, Hydrogen ion concentration, Carbon dioxide.

Surface oxygen uptake, sulfate reduction and total sediment metabolism were measured in sediments (0-30 cm) supporting stands of short Spartina alterniflora in a New England salt marsh. Surface oxygen uptake varied seasonally and was highly correlated with total sediment metabolism. Rates of oxygen uptake ranged from about 75 to 121 mmol/sq m/day during winter to a maximum in August of 363. Total carbon dioxide production followed the same trend with a winter low of 65 mmol/sq m/day and a maximum in August of 415. Porewater salinity was constant with depth, ranging between 31.7 and 31.9% In contrast, both pH and percent water varied with depth. The pH was lowest in the top 1 cm and rose to about pH 6.9 below 5 cm. The sulfate concentration in porewater from the 0-2 cm interval was about that expected from seawater at the salinity of the interstitial water. Below this depth sulfate decreased to values of about 21.6 mmol/liter. The rate of increase in carbon dioxide concentration at all depths in the sediment was linear through time. Time-course experiments using carbon dioxide production and sulfate reduction indicate that the aqua regia technique is not reliable for measuring sulfate reduction and that the rate of sulfate reduction is much less than previously reported for this marsh. Estimates of annual oxygen uptake conform with those of carbon dioxide production and below ground production. Carbon mineralization is estimated to average about 180 mmol C/sq m/day, among the highest measured for marine sediments. Simultaneous measurements of oxygen uptake, carbon dioxide production and sulfate reduction suggest that at least half of this decomposition occurs via sulfate reduction. (Baker-IVI)
W85-02790

**ABOVE- AND BELOWGROUND EMERGENT MACROPHYTE PRODUCTION AND TURNOVER IN A COASTAL MARSH ECOSYSTEM, GEORGIA,**
Georgia Univ., Sapelo Island. Marine Inst.
J. P. Schubauer, and C. S. Hopkinson.
Limnology and Oceanography, Vol. 29, No. 5, p 1052-1065, September, 1984. 6 Fig, 2 Tab, 47 Ref. Savannah State College contract R806728020.

Descriptors: *Coastal marshes, *Macrophytes, *Productivity, *Georgia, Primary productivity, Estuaries, Marshes, Seasonal variation, Distribution.

Seasonal patterns of above ground plant mass and the depth distribution of live roots, rhizomes, and dead below ground organic matter were measured for Spartina alterniflora and Spartina cynosuroides in Georgia tidal marshes. The estimates obtained of total net primary production for S. alterniflora and S. cyanosuroides (7,620 and 7,708 g dry mass/sq m/yr, respectively) are larger than any previously reported productivity values for salt and brackish marsh macrophytes based on harvest techniques. Below ground production was roughly 1.6 x above ground production. Turnover rates for below ground live material were 1.42/yr for S. cyanosuroides and 3.22/yr for S. alterniflora. The fate of root and rhizome material, including the extent to which such material enters the estuarine or near-shore food webs, is not clear. (Baker-IVI)
W85-02791

**SUSPENDED SEDIMENT RESPONSES IN A WIND-DOMINATED ESTUARY OF THE TEXAS GULF COAST,**
Minerals Management Service, Corpus Christi, TX.
For primary bibliographic entry see Field 2J.
W85-02835

**SOUTH AFRICAN ESTUARIES AND THEIR IMPORTANCE TO FISHES,**
Port Elizabeth Museum, Humewood (South Africa).
J. H. Wallace, H. M. Kok, L. E. Beckley, B. Bennett, and S. J. M. Blaber.
South African Journal of Science, Vol. 80, No. 5, p 203-207, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *South Africa, *Estuaries, *Fisheries, *Fish migration, Ecological effects, Species distribution, Migration, Estuarine environment.

South African estuaries represent a specialized environment; of a total of approximately 1500 species of fish found on the continental shelf, fewer than 100 species are able to make use of the estuaries. A mass migration by small juveniles of these species into estuaries is very marked during late winter, spring, and early summer; in the estuaries, high temperatures and a rich food supply favor rapid growth, and the juveniles are protected from most marine predators. The fish migrate back to sea with the onset of adolescence. Data from near-shore sampling programs have enabled the division of South Africa's estuary-associated fish fauna into six categories according to the extent of their dependence on estuaries. Of the 81 species which depend on estuaries, 29 are taken by anglers and an additional 21 are suitable for human consumption. Continuing degradation will result in a decline in South Africa's estuarine fish fauna and consequently in recreational angling, in the yield of high-protein food and in economic activities dependent upon this natural resource. (Collier-IVI)
W85-02837

**MACROBENTHIC COMMUNITIES OF THE LOWER CHESAPEAKE BAY. II. LYNNHAVEN ROADS, LYNNHAVEN BAY, BROAD BAY,AND LINKHORN BAY. BENTHIC STUDIES OF THE LOWER CHESAPEAKE BAY 5,**
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. H. Tourtellotte, and D. M. Dauer.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 1, p 59-72, 1983. 3 Fig, 6 Tab, 45 Ref.

Descriptors: *Chesapeake Bay, *Benthos, *Lynnhaven Bay, *Broad Bay, *Linkhorn Bay, *Virginia, Bays, Ecological distribution, Species diversity, Sediments, Macrobenthos, Water quality.

Preliminary data was sought on the subtidal macrobenthic communities of the Lynnhaven Bay system. Species distributions were examined in relation to sediment distributions. Most species dominant in clean sands were restricted to this sediment type, while most dominant species in sediments containing silt-clay were widely distributed. Ranges of indices of community structure were largest in clean sands which is probably the result of a combination of greater porosity and permeability of this sediment type and strong seasonal recruitment patterns. Species diversity was highest in fine sands containing silt-clay, due to spatial heterogeneity caused by a mixture of sediment types and particle reworking by species. Low diversity in Linkhorn Bay may indicate water quality problems resulting from urbanization of the shoreline. (Baker-IVI)
W85-02902

**USE OF OLIGOHALINE MARSHES BY FISHES AND MACROFAUNAL CRUSTACEANS IN NORTH CAROLINA,**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
L. P. Rozas, and C. T. Hackney.
Estuaries, Vol. 7, No. 3, p 213-224, September, 1984. 4 Fig, 6 Tab, 27 Ref.

Descriptors: *Salt marshes, *Oligohaline environment, *Fish, *Crustaceans, *North Carolina, Salinity, Rivulets, Seasonal variation, Nekton.

Fishes and invertebrate macrofauna (nekton) inhabiting three low salinity, intertidal rivulets were sampled biweekly from July 1981 through June 1982. Twenty-nine species of fishes (24,335 individuals, 9.671 kg wet weight) representing 19 families and four species of invertebrates (6,812 individuals, 4.708 kg wet weight) were collected. The most abundant species were spot (Leiostomus xanthurus), grass shrimp (Palaemonetes pugio), bay anchovy (Anchoa mitchilli) and Atlantic menhaden (Brevoortia tyrannus). Only a few large predacious fish (e.g., largemouth bass, Micropterus salmoides) were collected in the rivulets although largemouth bass and longnose gar (Lepisosteus osseus) were abundant in nearby permanently flooded area. The number of species was greatest during the warmer months and lowest during the winter. There were three seasonal peaks of numerical abundance: spring peak attributed to the influx of juvenile spot, Atlantic menhaden, Atlantic croaker (Micropogonias undulatus), and southern flounder (Paralichthys lethostigma); summer peak due to grass shrimp; and fall peak to bay anchovy and grass shrimp. The occurrence of these species was not correlated with salinity in the study area. Average densities of spot and Atlantic menhaden in the oligohaline rivulets at the peak of juvenile recruitment were similar to the average densities of these species reported for salt marshes. The results suggest that oligohaline estuarine areas contain important nursery habitat for some euryhaline species. (Author's abstract)
W85-02995

**DEWATERING OF AN UNVEGETATED MUDDY TIDAL FLAT DURING EXPOSURE - DESICCATION OR DRAINAGE,**
New Hampshire Univ., Durham. Dept. of Earth Sciences.
F. E. Anderson, and B. A. Howell.
Estuaries, Vol. 7, No. 3, p 225-232, September, 1984. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Intertidal areas, *Mud flats, *Dewatering, *Sediments, Drainage, Interstitial water, Salinity, Evaporation, Water content.

The water content of a surface sample of intertidal sediment reflects two time dependent processes. The first is the amount of evaporation or drainage which occurs with exposure, the second is the amount of consolidation that has taken place since deposition. An experiment to evaluate the effect of exposure on water content and salinity was conducted at Adams Cove, Great Bay, New Hampshire. The unvegetated muddy tidal flat was sampled to determine the changes in surface pore water content and salinity during exposure. During the summer, pore water salinities increased and the water contents decreased. The increasing salinities reflect a changing base salinity as precipitation and runoff decline during the summer months. The decreasing water content over the same period reflects a compaction or aging of the sediment, reducing the available pore surface. Local evaporation accounted for 61% of the upper intertidal surface salinity, with evaporation rates increasing salinity as high as 2.2% per hour. Daily changes in water content are only partially explained by exposure and evaporation, with the primary control being controlled permeability and drainage. (Moore-IVI)
W85-02996

**ESTIMATING WATER VOLUME DISCHARGE THROUGH SALT-MARSH TIDAL CHANNELS: AN ASPECT OF MATERIAL EXCHANGE,**
Delaware Univ., Lewes. Coll. of Marine Studies.
C. T. Roman.
Estuaries, Vol. 7, No. 3, p 259-264, September, 1984. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Canary Creek, *Delaware, *Flow discharge, *Salt marshes, *Tidal channels, Currents, Velocity, Tidal channels, Material exchange.

A knowledge of lateral current velocity variations is essential when attempting to accurately quantify the flux of materials through salt marsh-estuarine tidal creek cross-sections. Water volume discharge

estimates were made at a sample cross-section of the Canary Creek salt marsh (Lewes, Delaware). Canary Creek meanders for about 5 km and drains approximately 190 ha of Spartina alterniflora dominated marsh. To account for cross-sectional velocity variations, a dense spatial array of current meters was used. Simultaneous measurements were taken at hourly intervals over three complete tidal cycles. A practical method is presented whereby instantaneous average cross-sectional velocity, instantaneous cross-sectional discharge and tidal cycle discharge can be estimated from a dense current meter array, or ideal data set. A simplified spatial array can be used to estimate water discharges within acceptable error limits. Instantaneous cross-sectional discharges and total tidal cycle discharges were estimated with uncertainties of +/- 11% and +/- 7%, respectively. A preliminary study should be conducted to evaluate cross-sectional material concentration variability. If material concentrations vary significantly in the cross-section then detailed characterizations of concentration dynamics, with subsequent calibrations, must be conducted. (Moore-IVI)
W85-02998

**TWO-DIMENSIONAL MASS TRANSPORT IN ESTUARIES,**
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W.-S. Lung, and D. J. O'Connor.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1340-1357, October, 1984. 9 Fig, 1 Tab, 30 Ref, 1 Append.

Descriptors: *Estuaries, *Mass transport, Water circulation, Velocity, Hydrodynamics, Mathematical equations, Eddy viscosity, Salinity, Momentum.

On a tidally average basis, the two-dimensional estuarine circulation is characterized by a horizontal seaward velocity in the upper layer and a landward velocity in the lower layer, with a compensating vertical velocity to maintain hydraulic continuity. A relatively simple method of analysis is developed for this type of circulation from the hydrodynamic equations of momentum, continuity, and state. It is based on the condition that the salinity distributions in both the longitudinal and vertical directions are known or may be assigned. In addition to an analytical solution for the horizontal and vertical velocities, the analysis generates the values of vertical eddy viscosity which characterizes the vertical exchange of momentum, an important process of circulation in partially mixed estuaries. Successful applications of the analysis to a number of estuaries throughout the country prove that the present method is efficient and simple to use. The present method of analysis offers a definite advantage as a first approximation to this type of estuarine circulation. (Author's abstract)
W85-03006

**INITIAL TRANSIENTS IN LONG WAVE COMPUTATIONS,**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Civil and Systems Engineering.
For primary bibliographic entry see Field 8B.
W85-03008

**MATHEMATICAL MODEL STUDY OF THE FLUSHING CHARACTERISTICS OF A SHALLOW TIDAL BAY,**
Birmingham Univ. (England). Dept. of Civil Engineering.
R. A. Falconer.
Proceedings of the Institution of Civil Engineers, Part 2, Vol. 77, p 311-332, September, 1984. 10 Fig, 2 Tab, 21 Ref.

Descriptors: *Holes Bay, *England, *Mathematical models, *Bays, *Flushing, Model studies, Estuaries, Tidal bays, Wetlands, Land reclamation.

The development and application of a mathematical model to compare the hydraulic features and flushing characteristics of Holes Bay in Dorset for the present boundary configuration and for two proposed new outlines of the bay are described. There were two main numerical difficulties to be overcome in the mathematical model. Firstly, the narrow entrance associated with Holes Bay required the convective accelerations in the momentum equation to be treated carefully. Secondly, due to the nature of the bed topography of Holes Bay, extensive areas of marshland were dried out and flooded on each consecutive ebb and flood tide. A proposed land reclamation project for this area was examined, both with and without the emmbankment bridge, and shown that it would not improve either the exchange characteristics or the overmixing properties of Holes Bay. However, the detrimental effects that the land reclamation would have on the gross flushing characteristics appear to be relatively small. Holes Bay appears to have reasonably satisfactory flushing characteristics for the mean spring tide conditions when compared with similar results documented for a number of harbors and marinas where the flushing efficiency is known to be inadequate. (Baker-IVI)
W85-03052

**NOTE ON FLOW STRUCTURE IN THE GREAT OUSE ESTUARY,**
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, D. W. Knight, and K. Shiono.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 3, p 271-290, September, 1984. 10 Fig, 2 Tab, 21 Ref.

Descriptors: *Great Ouse Estuary, *England, *Estuaries, *Flow structure, Salinity, Velocity, Turbulence, Density gradients, Shear, Tidal effects.

The channels in estuaries are usually asymmetrical in cross-section, have a variation in bed material and bed structures across the channel, and have a longitudinal density gradient. The interaction of these phenomena with the tidal flow leads to vertical and transverse density gradients. Field measurements of vertical profiles of velocity and salinity along with turbulence measurements were used to examine the effect of density gradients on the flow structure in the Great Ouse estuary. During the flood tide shear and longitudinal density gradients cause well mixed conditions in the lower part of the water column. In the upper part of the water column the velocity profile shape could be explained by the presence of a transverse density gradient induced secondary flow and acceleration effects. On the ebb tide the vertical density gradient appears to be the dominant factor which determines the structure of the flow. Existing mathematical analyses of estuarine transport which consider only two dimensions, a similar flow structure for flood and ebb tides or small vertical density gradients may suffer from important deficiencies for some hydraulic conditions. The velocity profile data were used to obtain estimates of the bed shear stress for a flood and ebb tide. The values showed a cyclical variation with the flood values being considered more reliable due to the well-mixed nature of the flow near the bed. (Moore-IVI)
W85-03107

**SUMMERTIME NET TRANSPORT OF DISSOLVED OXYGEN, SALT AND HEAT IN A SALT MARSH BASIN, NORTH INLET, S.C.,**
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
L. R. Gardner, and C. Gorman.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 3, p 331-339, September, 1984. 6 Fig, 10 Ref. NSF grant SM176-02406.

Descriptors: *Salt marshes, *Dissolved oxygen, *Salt, *Heat, *North Inlet, *South Carolina, Solute transport, Tidal effects, Solar radiation, Coastal waters.

This study addresses the impact marshes have on the dissolved oxygen content of tidal waters, particularly during summer when respiratory demand for oxygen in adjacent coastal waters is at a maximum and the solubility of oxygen is lowest. The net transports of dissolved oxygen, salt and heat have been measured for 65 tidal cycles during late spring and summer for a small (0.14 sq km) salt marsh basin near North Inlet, S.C. The results indicate that export of dissolved oxygen occurs only on tidal cycles that begin between 2:00 am and 10:00 am such that high tide occurs within 4 h of noon. The largest exports of oxygen and heat are produced by spring tides beginning near sunrise. Although the time window for oxygen export is only about 8 h in duration, there is a more or less overall long-term balance between export and import because the magnitude of oxygen export is about 25% greater than import. The magnitude of heat export similarly exceeds heat import but because the time windows for heat export and import are equal, there is an overall export of heat. This study thus suggests that in summer salt marshes of the Atlantic coast export heat and are in balance with respect to the export and import of dissolved oxygen. However, because of the interaction of the diurnal tide with the daily cycle of solar radiation, transient dissolved oxygen concentrations in tidal waters can range from 1.5 to 10.0 ppm. Thus loading of additional oxygen consuming materials to these waters possibly could lead to significant periods of anoxia. (Author's abstract)
W85-03108

**HEAVY METALS IN A CONTAMINATED AUSTRALIAN ESTUARY - DISPERSION AND ACCUMULATION TREND,**
Aix-Marseille-1 Univ. (France).
For primary bibliographic entry see Field 5B.
W85-03109

**OXYGEN PRODUCTION IN A BAY WITHIN THE FRESHWATER SECTION OF THE ELBE ESTUARY. AN INVESTIGATION OF THE MUHLENBERGER LOCH IN HAMBURG (DIE SAUERSTOFFPRODUKTION EINER BUCHT IM SUSSWASSERBEREICH DES ELBE-AESTUARS UNTERSUCHUNGEN IM 'MUHLENBERGER LOCH' IN HAMBURG),**
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 6G.
W85-03121

**EFFECTS OF SALINITY ON PREFERRED AND LETHAL TEMPERATURES OF THE BLACKCHIN TILAPIA, SARATHERODON MELANOTHERON,**
Pennsylvania State Univ., University Park. School of Forest Resources.
J. R. Stauffer, Jr., D. K. Vann, and C. H. Hocutt.
Water Resources Bulletin, Vol. 20, No. 5, p 771-775, October, 1984. 4 Tab, 24 Ref.

Descriptors: *Fish, *Salinity, *Acclimatization, Adaptation, Estuaries, Acidity, Dissolved oxygen, Temperature effects, Population dynamics, Distribution.

The possibility that acclimation to different salinities affects the preferred and lethal responses of the blackchin tilapia, Sarotherodon melanotheron was investigated. It would appear that cool temperature is the most important parameter which limits the dispersal of these cichhlids. S. melanotheron is euryhaline and can probably disperse further northward in brackish water than in freshwater or marine environs. Although relatively stenothermal in freshwater, it can withstand temperatures outside of its zone of tolerance for short time periods. Furthermore, when acclimated to cold temperatures, it does select temperatures well within its zone of tolerance. S. melanotheron's thermal tolerance zone may be expanded, depending upon salinity. This possibility suggests that the species could expand its range in North America. (Baker-IVI)
W85-03143

**BIOCHEMISTRY OF ACETATE IN ANOXIC SEDIMENTS OF SKAN BAY, ALASKA,**
Alaska Univ., Fairbanks. Inst. of Marine Science.
D. G. Shaw, M. J. Alperin, W. S. Reeburgh, and D. J. McIntosh.

Geochimica et Cosmochimica Acta, Vol. 48, No. 9, p 1819-1825, September, 1984. 4 Fig, 1 Tab, 31 Ref.

Descriptors: *Acetate, *Skan Bay, *Alaska, *Anoxic sediments, Bays, Sediments, Biogeochemistry, Oxidation, Sulfates, Organic matter, Bacteria.

The role of acetate in the biogeochemical cycling of organic matter in contemporary marine anoxic sediments of Skan Bay, Alaska was investigated with inhibition and quasi in situ turnover experiments. The turnover time for acetate oxidation in the upper 30 cm of the sediment column is about 1 hr. A molybdate inhibition experiment indicated that sulfate reducing bacteria were responsible for more than 95% of acetate oxidation. The measured rate of acetate oxidation is too great to be balanced by the measured rates of sulfate reduction. One explanation for this fact is that only a fraction of the measured porewater concentration of acetate is microbially available, leading to errors in the rate determinations. Acetate is oxidized to carbon dioxide in Skan Bay sediments with rate constants comparable to those observed in other anoxic marine sediments. Acetate is not converted to methane in the upper 30 cm of sediment. Methane production from acetate occurs only at 2 m. Most of the acetate oxidation is inhibited by 20 mM sodium molybdate and is therefore probably mediated by sulfate reducing bacteria. A portion, perhaps 10% to 40%, of added acetate is rapidly sorbed to sediment particles. (Baker-IVI)
W85-03207

**DESORPTION AND COAGULATION OF TRACE ELEMENTS DURING ESTUARINE MIXING,**
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2K.
W85-03208

**MIXING AND CYCLING OF URANIUM, THORIUM AND 210-PB IN PUGET SOUND SEDIMENTS,**
Washington Univ., Seattle. School of Oceanography.
R. Carpenter, M. L. Peterson, J. T. Bennett, and B. L. K. Somayajulu.
Geochimica et Cosmochimica Acta, Vol. 48, No. 10, p 1949-1963, October, 1984. 6 Fig, 4 Tab, 53 Ref.

Descriptors: *Uranium, *Thorium, *Lead radioisotopes, *Puget Sound, *Washington, *Sediments, Estuarine environment, Radioisotopes, Seawater, Manganese oxides, Particulates.

The relative importance of Pb, U and Th isotope sources differs greatly for Puget Sound sediments. Atmospheric input accounts for one-half to one-third the excess Pb-210, but is negligible for all other isotopes considered. Only for the short-lived excess Th-234 is in situ production in overlying seawater important. Detrital particles, entering primarily from rivers, are the only significant sources of Th-232 and Th-230 and provide roughly one-half the excess Pb-210 and most of the U-324 and U-238. Advecting seawaters introduce little dissolved Th-232 and Th-230 into Puget Sound because their particle reactivity causes them to be scavenged before the waters reach Puget Sound, and their long half lives prevent significant production in Puget Sound. Inflowing seawaters bring relatively large amounts of dissolved U into Puget Sound, but scavenging reactions are not effective at removing it unless waters are biologically pumped down into sediments where mildly reducing conditions develop. In Dabob Bay Pb-210 is transported to the seafloor by sinking zooplankton fecal material, extensively reworked by the benthos and reincorporated primarily into hydrous Mn oxides. Pb-210 is also associated with hydrous Mn oxides in sediments of other areas of Puget Sound. Excess Th-234 profiles in sediment reveal considerable detail about the dynamic nature and recent history of mixing processes. Mixing coefficients and layer thicknesses derived from a best fit of a four layer diffusion-advection-decay model to the Th-234 data adequately describe the corresponding Pb-210 profiles within the surface mixed layer. This indicates mixing processes are influencing the sedimentary profiles of both isotopes in an equivalent, depth dependent manner. (Baker-IVI)
W85-03209

**BIOGEOCHEMICAL CYCLING IN AN ORGANIC-RICH COASTAL MARINE BASIN; 4. AN ORGANIC CARBON BUDGET FOR SEDIMENTS DOMINATED BY SULFATE REDUCTION AND METHANOGENESIS,**
North Carolina Univ. at Chapel Hill. Marine Sciences Program.
C. S. Martens, and J. Val Klump.
Geochimica et Cosmochimica Acta, Vol. 48, No. 10, p 1987-2004, October, 1984. 12 Fig, 6 Tab, 48 Ref. NSF grants OCE 80-09245 and OCE 82-08666.

Descriptors: *Chemical reactions, *Estuarine environment, *Methanogenesis, *Sulfates, *Cape Lookout Bight, *North Carolina, *Outer Banks, Lagoons, Carbon cycle, Carbon dioxide, Methane, Seasonal variation, Cycling nutrients, Organic carbon.

The organic carbon deposition rate at Station A-1 in Cape Lookout Bight, North Carolina is calculated to be 149 mmole/sq m/yr during the late 1970's. Of this input, 35.6 mmole/sq m/yr is recycled to overlying waters from the sediments, 84 as total CO2 and 16 as methane. Most of the recycling takes place during warm summer months via diffusion of carbonate and gas bubble ebullition of methane. At least 24.4 mmole/sq m/yr of the upward total carbon dioxide flux representing 68% of the total measured upward carbon flux is produced in association with sulfate reduction. Methanogenesis accounts for approximately 32% of the net carbon flux assuming equal amounts of CO2 are produced with methane beneath the zone of sulfate reduction. The mean residence time of metabolizable organic carbon in the upper 80 cm at Station A-1 is calculated to be 4.3 months with greater than 98% of the remineralization occurring in the upper 25 cm. (Baker-IVI)
W85-03211

# 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

## 3A. Saline Water Conversion

**STUDIES ON PERFORMANCE OF DESALINATION PLANT BY REVERSE OSMOSIS SYSTEM - II; EFFECTS OF INHIBITION OF BACTERIAL GROWTH WITH NAHSO3 ON PERFORMANCE OF PLANT (IN JAPANESE),**
Shimonoseki Univ. of Fisheries (Japan).
S. Hikasa, H. Matsushita, M. Yasunari, and T. Kirihata.
Journal of Shimonoseki University of Fisheries, Vol. 32, No. 1-2, p 15-22, January, 1984. 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Reverse osmosis, *Desalination plants, *Sulfates, Membrane process, Seawater, Saline water, Ships.

A fresh water generating plant equipped with a reverse osmosis module is the most suitable system for small ships. However, the performance of this plant is influenced remarkably by different factors, such as sea water temperature and suspended substances in seawater. In this experiment, NaHSO3 was added to the feedwater once a day, and its concentration was adjusted to 60 ppm. This treatment inhibited bacterial growth on the filter medium and decreased remarkably the adhesion of bacteria on the surface of the reverse osmosis module. This treatment was very effective for maintaining the desalting performance of the plant. (Author's abstract)
W85-02838

**REFRIGERATOR-HEAT-PUMP DESALINATION SCHEME FOR FRESH-WATER AND SALT RECOVERY,**
Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
M. Reali.
Energy, Vol. 9, No. 7, p 583-588, July, 1984. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Desalination, *Heat pumps, *Refrigeration, *Vapor pressure, Saline water, Salt, Condensation, Solar energy, Wind energy, Seawater, Brine.

This study concerns a refrigerator-heat-pump desalination scheme (RHPDS), which allows energy-efficient recovery of fresh water and salt from the sea. In this scheme, a salt-water chamber is continuously refilled with sea water via atmospheric pressure. Sea water is evaporated into a vacuum chamber and the water vapor is condensed on top of a fresh-water chamber. A refrigerator-heat-pump circuit maintains the two water chambers at suitably different operating temperatures and allows efficient recovery of the latent heat of condensation. The scheme is analyzed with special consideration to potential exploitation of renewable energy sources such as solar and wind energy. (Author's abstract)
W85-02957

## 3B. Water Yield Improvement

**CIRCULAR VS. LINEAR WATER SYSTEMS, GOING BACK TO NATURE'S WAY,**
Sheaffer and Roland, Inc., Chicago, IL.
For primary bibliographic entry see Field 6A.
W85-03039

**PARAFFIN-WAX WATER-HARVESTING SOIL TREATMENT IMPROVED WITH ANTISTRIPPING AGENTS,**
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. H. Fink.
Soil Science, Vol. 138, No. 1, p 46-53, July, 1984. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Water harvesting, *Paraffin wax, *Antistripping agents, Soil treatment, Soil erosion, Cellulose xanthate, Weathering.

The paraffin-wax water-harvesting soil-treatment is being used in arid areas to supply precipitation-runoff water for a variety of agricultural uses. However, because paraffin has only weak van der Waals-type binding forces, it may, under adverse weathering conditions, be easily stripped off the soil by the wedging action of water acting at the wax-soil interface. Addition of 2 to 4% antistripping agent (compounds added to asphalt during highway construction to strengthen the asphalt-aggregate interfacial bond) to the paraffin-wax water-harvesting soil treatment markedly improved the treated soil's resistance to the weathering effects of freeze-thaw cycling and water erosion. Addition of the better of the nine antistrip compounds tested permitted a reduction of the wax application rate of 0.5 kg/sq m. Prior stabilization of the soil with cellulose xanthate reduced the required wax/antistrip rate to only 0.25 kg/sq m. This is 1/8 the currently recommended application rate of wax for soils exposed to freeze-thaw weathering. (Author's abstract)
W85-03091

## 3C. Use Of Water Of Impaired Quality

**SALINITY AND ALFALFA YIELD UNDER EFFLUENT IRRIGATION IN SOUTHWESTERN SASKATCHEWAN,**
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
Y. W. Jame, V. O. Biederbeck, W. Nicholaichuk, and H. C. Koven.

Canadian Journal of Soil Science, Vol. 64, No. 3, p 323-332, August, 1984. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Irrigation, *Water reuse, *Wastewater irrigation, *Salinity, Plant growth, Crop yield, Alfalfa, Saskatchewan, Swift Current.

The effect of wastewater irrigation on soil salinity and crop yield was determined in a study at Swift Current, Saskatchewan. If managed properly it is safe to use the saline sewage effluent for irrigation without seriously affecting alfalfa production. With the average EC of the sewage effluent as high as 2.6 dS/m, an over irrigation of 10-15% above the normal recommended application rate will provide sufficient water to leach through the profile and thus maintain a salt balance in the root zone favorable for plant growth. With this application rate, it is expected that in the well-drained soils the salinity level in the upper layer of the root zone will approach an ECe value of 2.5 dS/m and ECe will increase with depth with the value near the bottom of the root zone in the range of 4-6 dS/m. With salinity at this level, it is possible to maintain production at more than 85% of that on nonsaline soils when nutrients are not limiting growth. Higher rates of application are not recommended because they would reduce the productivity per unit water applied, increase the risk of leaching potentially harmful chemicals into the ground water and may also result in management problems unless surface drainage is provided. Salts will accumulate more readily in the root zone and cause more serious salinity problems in the presence of the high water table as compared to the well-drained soils. (Baker-IVI)
W85-02802

**REUSE OF AGRICULTURAL DRAINAGE WATERS: AN ECONOMIC ANALYSIS,**
California Univ., Riverside.
K. C. Knapp, and A. Dinar.
Water Resources Bulletin, Vol. 20, No. 4, p 521-525, August, 1984. 5 Tab, 9 Ref.

Descriptors: *Water reuse, *Drainage water, *Irrigation water, *Economic evaluation, *California, Salinity, Impaired water use, Salt tolerance, Oranges, Grapes, Lettuce, Alfalfa, Wheat, Cotton.

Many western agricultural areas are facing increased water costs and in some cases reduced supplies from primary water sources. At the same time some areas are suffering from drainage problems associated with high water tables. A possible response to both problems is to reuse the agricultural drainage water for irrigating crops. The profitability of reusing agricultural drainage water for crop production depends on the salt tolerance of the crop being grown, the salt concentration of the drainage water, the cost of obtaining it, and the price of good water. The economics of drainwater reuse is examined for navel oranges, grapes, lettuce, alfalfa, wheat, and cotton in the Imperial/Coachella Valley and Kern County areas of southern California. Drainwater reuse is not profitable for the fruit and vegetable crops considered but may be profitable for the field crops considered when the price of good water is relatively high and the cost of obtaining drainage water of reasonable quality is low. (Moore-IVI)
W85-02978

**SALT GRADIENT PONDS: INVESTMENT TIMING MODEL,**
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
T. C. Hughes, and S. Orlovsky.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 403-417, October, 1984. 4 Fig, 3 Tab, 10 Ref, 2 Append.

Descriptors: *Salt gradient solar ponds, *Investment, *Impaired water use, *Colorado River basin, *Thermal powerplants, Saline water, Mathematical models, Salinity management, Economic aspects, Solar energy.

Salt gradient solar ponds can play an important role in management of river salinity in semiarid locations such as the Colorado River Basin. A mathematical model and solution procedures are presented for investment timing of expansion of a salt gradient pond system. An application of the model is presented for several sites in the upper Colorado River basin where planned fossil fuel electric generating plants are located near existing source of saline or brackish water. The concept involves use of both concentrated brine waste streams from the power plants and the existing low quality water sources for the pond system water and salt demands. The salt gradient pond can: (1) Replace a power plant's customary zero discharge evaporation; (2) produce additional energy; and (3) remove much more salt from the river system than the conventional evaporation pond. An economic model solution procedure and application are presented for expansion of salt gradient solar pond systems. Such systems have important potential for salinity management applications, when used in conjunction with thermal/electric plants near sources of saline water. (Author's abstract)
W85-03061

**EFFLUENT IRRIGATION OF PARA GRASS: WATER, NITROGEN, AND BIOMASS BUDGETS,**
Florida International Univ., Miami. Drinking Water Quality Research Center.
L. L. Handley, and P. C. Ekern.
Water Resources Bulletin, Vol. 20, No. 5, p 669-677, October, 1984. 2 Fig, 7 Tab, 46 Ref.

Descriptors: *Land disposal, *Wastewater irrigation, *Nitrogen, *Hawaii, Irrigation, Grass, Water budget.

Biological methods for wastewater renovation and groundwater recharge were sought which would be suitable for Hawaiian soils, vegetation, and climate. Both water and nitrogen balances showed that irrigation of para grass was an effective means of removing nitrogen from domestic sewage effluent. With irrigation amounts of up to 510 mm/week beyond rainfall and average evapotranspiration of 32 mm/week, most of the irrigation percolated for possible groundwater recharge. An excellent nitrogen sink, the harvested crop removed as much as 173 mkg/ha/mo of nitrogen, eight times the amount removed by sugarcane and four times the amount removed by Bermuda grass. With effluent averaging 34 g/L nitrogen and average irrigation rates as great as 98 mm, 5 times/week, percolate nitrate-nitrogen levels were below the critical 10 mg/L for potable water. At highest application of 2,600 kg/ha/yr nitrogen, the crop used more than 80% of applied nitrogen; percolate accounted for 9% and gaseous loss accounted for less than 11%. With harvest intervals varying from 6 to 13 weeks crop productivity was linear with applied nitrogen and averaged 110 t/ha/yr of dry matter with a maximum of 159 t/ha/yr. Under consistent effluent irrigation, there was no significant seasonality to productivity in an area where soil temperatures remained about 18 C. At the maximum nitrogen application rate, forage had a calculated crude protein content of 13%, dry weight, and a caloric value of 4,000 kcal/kg of dry matter. Toxic nitrate-nitrogen in the fodder did not occur with effluent containing up to 59 mg/L total nitrogen. The crop required minimal maintenance. (Baker-IVI)
W85-03132

## 3D. Conservation In Domestic and Municipal Use

**WATER CONSERVATION, RECYCLING, AND REUSE: U.S. NORTHEAST,**
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
E. Kaplan.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 455-477, October, 1984. 14 Tab, 20 Ref. DOE contract DE-AC02-76CH00016.

Descriptors: *Water conservation, *Water reuse, *Recycling, Water use, Consumptive use, Domestic water, Industrial water, Agriculture, Utilities, Electric power production, Water supply.

This paper focuses upon present and future possibilities for water conservation, recycling, and reuse in New England and Middle Atlantic states. Telephone interviews and questionnaries sent to trade associations, public utility commissions, federal, state and other agencies were used to supplement information gathered in the literature. Water intake and consumptive demands in 1980 were calculated for industrial, electric utility, agricultural, and residential sectors. Corresponding information for the year 2000 were estimated using data from utilities, public utility commissions, and the U.S. Bureau of Economic Affairs. Water supplies were estimated using the concept of safe yield. Assuming reductions in water use by industries, agriculture and by private residences in the year 2000, it was found that many users, particularly the electric utility sector, would still experience serious water supply shortfalls in several industrialized states. (Author's abstract)
W85-03064

## 3E. Conservation In Industry

**WATER SUPPLY FOR POWER IN TEXAS-GULF REGION,**
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
B. F. Hobbs.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 373-391, October, 1984. 3 Fig, 3 Tab, 40 Ref. DOE contract W-7405-eng-26.

Descriptors: *Cooling water, *Powerplants, *Water conservation, *Water demand, *Water supply development, *Texas, Linear programming, Mathematical models, Cost analysis, Institutional constraints, Water reuse.

In order for the Gulf region of Texas to accomodate projected growth in electric generating capacity, additional water supplies will have to be obtained, or alternate cooling methods used. Most water-energy assessments have considered only a few supply types and conservation technologies. A linear program is developed that incorporates: supply curves for several water sources that reflect institutional constraints; and water demand curves based on the cost of alternative power plant cooling methods. By focusing on a single region, the model can incorporate cost information for several types of water supplies for each of a large number of subbasins. A base case model solution for the year 2000 is discussed. Sensitivity analyses and scenarios for the year 2030 are also presented. For the Texas-Gulf region in the year 2000, the high cost of dry or mixed wet/dry cooling is unjustified unless: new technologies lower the incremental cost of wet/dry cooling by more than 80%; or unforeseen institutional restrictions prevent utilities from securing economic surface and ground water supplies. This conclusion contradicts previous studies which projected serious water-energy conflicts for the region. This study finds differently because it considers alternative water sources that utilities are beginning to use throughout the West, including groundwater, water rights transfers, interbasin diversions, and sewage plant effluent. (Moore-IVI)
W85-03059

**WATER CONSERVATION, RECYCLING, AND REUSE: U.S. NORTHEAST,**
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
For primary bibliographic entry see Field 3D.
W85-03064

## 3F. Conservation In Agriculture

**IMPACT ON GROUNDWATER RESOURCES OF CONVERSION FROM FURROW TO DRIP IRRIGATION,**
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
H. Yamauchi.
Water Resources Bulletin, Vol. 20, No. 4, p 557-563, August, 1984. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Drip irrigation, *Furrow irrigation, *Groundwater recharge, *Sugarcane, *Hawaii, Groundwater potential, Water conservation, Groundwater depletion, Crop yield, Surface water.

The adoption of more efficient irrigation practices in agriculture is often regarded as an economical means of reducing the competition for scarce water supplies between agricultural, and nonagricultural demands. A model is developed to analyze the groundwater conservation and depletion effects of converting sugarcane irrigation from the furrow to the drip method. With drip irrigation, whatever gains there are in water application efficiencies over furrow irrigation must be gaged against the potential for expanded irrigation and the relative reductions in recharge. Conversion to drip can significantly reduce under-irrigation and also expand on total irrigated acres. In theory, shrinkage of groundwater fields through substitution of imported surface water sources can offset some of the depletion effects of reduced recharge, but this has not been shown to be the case in Hawaii. As long as drip promises increased profitability through higher yields and lower production costs, the tendency for increased metropolitan competition for and depletion of common groundwater resources will not necessarily be alleviated by conversion to drip irrigation. (Moore-IVI)
W85-02982

**ECONOMICS OF CHANGES IN IRRIGATION MANAGEMENT IN PAKISTAN: AN INTEGRATIVE MODELING APPROACH,**
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
S. H. Johnson, III, and J. O. Reuss.
Water International, Vol. 9, No. 2, p 66-71, 1984. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Irrigation practices, *Model studies, *Pakistan, *Economic aspects, Water management, Planning, Wells, Groundwater, Water supply development, Irrigation.

Alternative irrigation management systems at the distributary level were investigated and their economic impacts were measured at the farm level. This was accomplished by using an integrative simulation model developed to represent conditions in the Punjab, the largest state in Pakistan. Restricted demand systems as well as conjunctive systems supplemented with ground water were examined using the model. Results indicate that canal closure in February to April, rather than December and January, would increase per hectare returns by US $15-35. Due to the limited capacity of the present canals, changing from a continuous flow to a demand system does not appear to be economically feasible. If sufficient ground water were to be pumped from public tube wells this would require more than 850 million dollars in capital costs not to mention maintenance and energy subsidy costs. Pumping this supplemental water from private wells is much more appealing as it removes the need for additional public investment in ground water development and facilitates decentralization of operation. Shallow private wells, in contrast to deeper, public tube wells, are also environmentally better as they usually pump higher quality water. (Baker-IVI)
W85-03029

# 4. WATER QUANTITY MANAGEMENT AND CONTROL

## 4A. Control Of Water On The Surface

**CLIMATE AND THE COLORADO RIVER: THE LIMITS OF MANAGEMENT,**
National Center for Atmospheric Research, Boulder, CO.
S. L. Rhodes, D. Ely, and J. A. Dracup.
Bulletin of the American Meteorological Society, Vol. 65, No. 7, p 682-691, July, 1984. 6 Fig, 4 Tab, 26 Ref.

Descriptors: *Flood control, *Water management, *Colorado River, *Climates, *Lake Mead, *Lake Powell, Floods, Management, River basins, Runoff, Snowmelt, Planning, Arizona, California, Mexico.

During the late spring of 1983, unusually heavy snowmelt runoff in the Upper Colorado River Basin resulted in flooding, primarily below Parker Dam, and economic losses in the River's lower basin in Arizona, California, and Mexico. This fooding was the result of the convergence of three factors: the reservoir system along the Colorado generally has been full since the summer of 1980; there has been a gradual physical encroachment into the lower basin flood plain over the last 20 years; and the natural climatic variability of the basin happened to produce a large amount of runoff during the late spring of 1983. The rapid sequence of meteorological events occurring late in the spring, coupled with the problem of attempting to move massive amounts of water through Lakes Powell and Mead in a short period of time, resulted in streamflows above those that lower basin residents and businesses had come to expect. The interplay of the three factors that contributed to the 1983 flooding in the Lower Colorado Basin could recur in 1984 as well as in later years. Given that climate variability is beyond the control of the river's managers, attention must be focused on flood plain encroachment and the question of how much storage space should be dedicated to flood control in Lake Mead and upstream. (Baker-IVI)
W85-02799

**MACROPHYTE COMMUNITY DYNAMICS IN DREDGED WISCONSIN LAKE,**
Wisconsin Geological and Natural History Survey, Madison.
S. A. Nichols.
Water Resources Bulletin, Vol. 20, No. 4, p 573-576, August, 1984. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Macrophytes, *Dredging, *Lilly Lake, *Wisconsin, *Lake rehabilitation, Revegetation, Aquatic plants, Recreation.

Lilly Lake is a 37 ha, natural, hard-water lake in Kenosha County, Wisconsin. Between July 1978 and June 1980 the entire lake was dredged to a sand bottom or a depth of 4 m as part of a lake renewal effort. The macrophyte community was studied before and for three growing seasons after dredging. In water depths up to 1.5 m, revegetation was rapid after dredging. The plant community changed from one dominanted by large-leafed Potamogeton (pondweed), Megalodonta beckii (water marigold), and Elodea canadensis (waterweed) to one dominated by Chara (stonewort), Najas flexilis (naiad), and Myriophyllum (milfoil). Prior to dredging, because of the shallow water depth and high water transparency, the entire lake bottom was covered with vegetation. After dredging, plant growth ceased at about the 4 m depth. Growth recovered much more slowly in water depths between 1.5 and 4 m. The area between 1.5 m and 2.5 m in particular supported a monotypic milfoil stand after dredging. Under predredging conditions a majority of the macrophytes reached the water surface, where they hampered water use. After dredging, macrophytes in the 2.5-4 m depth zone seldom grew high enough in the water column to interfere with surface water use. Dredging allowed about 80% of the previously unusable surface are to be open for recreation. (Moore-IVI)
W85-02984

**DETERMINATION OF CROP PRODUCTION LOSS DUE TO INADEQUATE DRAINAGE IN A LARGE WATERSHED,**
Iowa State Univ., Ames. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W85-02987

**OUTPUT INCREASE FROM EXISTING HYDROELECTRIC PLANTS,**
Hydrologic Engineering Center, Davis, CA.
D. W. Davis, and J. J. Buckley.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 361-372, October, 1984. 5 Fig, 5 Tab, 5 Ref.

Descriptors: *Hydroelectric plants, *Electric power production, Turbines, Electrical equipment, Hydroelectric power, Flood control storage, Water resources development.

The potential for increasing the energy output was investigated at all existing hydroelectric plants in the US, regardless of ownership, for increases through enlarging power-houses, modifying or replacing turbines and generators, and improving water handling works. The hydroelectric power generation system analyzed in this study is comprised of 1,288 individual plants, totaling about 3,000 individual generation units, with installed capacity of 63,375 MW, generating 272,552 gigawatt hr of electrical energy per year. The potential energy increase was found to be about 11% requiring an increase of 22% in installed capacity. Virtually all the increase due to capturing existing spill through enlargement of existing powerhouses (adding additional units). Equipment uprating and improvements only would likely contribute on an aggregate national scale no more than 1.4% increase. Potential for increased energy output from operational improvements and storage reallocation is possible at sites with existing flood control storage (a national aggregate increase of about 0.6%). The existing hydropower generation system on the whole is making quite efficient use of the energy resources available at the existing sites. (Moore-IVI)
W85-03058

**ESSENTIAL URBAN DETENTION PONDING CONSIDERATIONS,**
Wright Water Engineers, Inc., Denver, CO.
J. E. Jones, and D. E. Jones, Jr.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 418-433, October, 1984. 8 Ref.

Descriptors: *Detention reservoirs, *Urban runoff, *Runoff management, Storm runoff, Planning, Community development.

Widespread misapplication of detention ponding is probably attributable to the simplicity and attractiveness of its basic concept, combined with lack of awareness or appreciation of complex interrelationships which influence its performance in urban drainage systems. There is urgent need to properly relate runoff management and flood plain management to total urban water resource management. Some fundamental and peripheral considerations that often bear upon proper integration of detention ponding into urban water resource management are reviewed. The most frequently encountered problem with detention ponding is the way it has been implemented out of context, by itself, as a mechanism for reducing peak runoffs from individual development sites. Communities should develop detention ponding programs only if they have the desire to manage creatively and effectively their stormwater problems and improve the living environment for the public. The level of community commitment required and the importance of multipurpose facilities are often underestimated. A wide variety of operational, maintenance, attitudinal and institutional questions should be individually addressed during planning and design decision making. (Moore-IVI)
W85-03062

**LIMNOLOGICAL CHANGES IN A SMALL LAKE STOCKED WITH GRASS CARP,**
Ministry of Agriculture and Fisheries, Rotorua (New Zealand). Fisheries Research Div.
C. P. Mitchell, G. R. Fish, and A. M. R. Burnet.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 2, p 103-114, July, 1984. 9 Fig, 24 Ref.

Descriptors: *Grass carp, *Aquatic weed control, *Parkinson Lake, *New Zealand, Biological control, Dissolved oxygen, Water temperature, Water level, Nutrients, Zooplankton, Chlorophyll a.

A heavy infestation of aquatic weeds (Egeria densa and Eleocharis sphacelata) in a 1.92 ha lake (Parkinsons Lake, North Island, New Zealand) disappeared within 2 years of the introduction of Chinese grass carp (Ctenopharyngodon idella Val). The elimination of aquatic plants did not result in any significant change in dissolved oxygen, water temperature, or annual fluctuations in lake levels over the successive 2 years. Dissolved inorganic phosphorus concentrations did not increase appreciably although there was a short term rise in particulate phosphorus levels. Oxidized nitrogen fluctuations were small in the lake over the experimental period. Some reduction in water transparency occurred although chlorophyll a levels showed no overall increase. There were increases in zooplankton numbers and biomass. A large increase of ammonium nitrogen in the lake accrued 12 months after all macrophytes had been eliminated, this possibly was a result of heavy use of inshore water by cattle. (Author's abstract)
W85-03071

**SOME EFFECTS OF EUTROPHICATION AND THE REMOVAL OF AQUATIC PLANTS BY GRASS CARP (CTENOPHARYNGODON IDELLA) ON RAINBOW TROUT (SALMO GAIRDNERII) IN LAKE PARKINSON, NEW ZEALAND,**
Ministry of Agriculture and Fisheries, Rotorua (New Zealand). Fisheries Research Div.
For primary bibliographic entry see Field 5C.
W85-03072

**CONTROL OF ECHINOCHLOA STAGNINA (RETZ.) P. BEAUV. BY HARVESTING FOR DRY SEASON LIVESTOCK FODDER IN LAKE KAINJI, NIGERIA - A MODELLING APPROACH,**
Imperial Coll. at Silwood Park, Sunninghill (England).
A. J. Morton, and E. A. Obot.
Journal of Applied Ecology, Vol. 21, No. 2, p 687-694, August, 1984. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Lake Kainji, *Nigeria, *Aquatic weed control, *Fodder, *Reservoirs, Hydroelectric plants, Harvesting, Standing crop, Grasses, Model studies.

The annual grass, Echinochloa stagnina is the major component of the emergent vegetation of Lake Kainji, Nigeria. The Kainji dam was built mainly for the genration of hydroelectric power, and the power generation authority views the grass as a problem and a threat to the life expectancy of the lake because of water displacement by E. stagnina and increased silting associated with its growth. The grass is a valuable spawning and breeding ground for economically important fish, and the grass is a valuable source of fodder for cattle during the dry season. A possible solution which takes into account all of these interests is the controlled harvesting and utilization of E. stagnina. A simple model of the colonization potential of E. stagnina is described and is used as a means of exploring the effects of harvesting of the grass. Between 28% to 46% of the Lake's surface could have been covered by E. stagnina during the years 1972-1983. Approximately 75% of the E. stagnina standing crop could be cut for harvest each year on a sustainable basis, assuming a colonization factor of 5.1 and assuming constant productivity from year to year. (Moore-IVI)
W85-03077

## 4B. Groundwater Management

**INVESTIGATION INTO THE EFFECT OF DIFFERENT PUMPING REGIMES ON DRAWDOWN IN LARGE DIAMETER WELLS,**
Birmingham Univ. (England). Dept. of Civil Engineering.
S. Holt, and K. R. Rushton.
Hydrobiological Sciences Journal, Vol. 29, No. 3, p 271-278, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Aquifers, *Drawdown, *Water supply development, *Wells, Water management, Transmissivity, Pumping regime,.

The response of large diameter wells to different short and long term pumping regimes has been investigated using a numerical model. The short term investigation shows that for a single pumping phase, a major proportion of the water withdrawn comes from well storage and it is not until recovery that most of the aquifer yield occurs. The nature of the pumping regime does influence the variation in well water level and aquifer drawdown. An increase in the number of phases leads to a decrease in the maximum drawdown in the well. The use of two or three pumping phases each day rather than single phase does bring considerable advantage. For long term pumping the objective is to withdraw the maximum amount of water from the aquifer without drawdown in the well becoming excessive. For the particular aquifer configuration considered, 40 cu m abstracted each day is a suitable overall rate. There is little difference in the number of days to failure between constant abstraction and one, two or three phases each day. When more water is abstracted each day it is advantageous to adopt two phase pumping rather than one phase each day. Whatever pumping regime is used, as more water is abstracted each day the proportion of available water utilized becomes less. In the extreme, excessive drawdown can occur after one day with only 2% of the available water used. (Baker-IVI)
W85-02826

**EIGENVALUE TECHNIQUE FOR SOLUTE TRANSPORT,**
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-03004

**IDENTIFICATION OF AN OPTIMAL GROUNDWATER MANAGEMENT STRATEGY IN A CONTAMINATED AQUIFER,**
Kansas State Geological Survey, Lawrence.
S. J. Colarullo, M. Heidari, and T. Maddock, III.
Water Resources Bulletin, Vol. 20, No. 5, p 747-760, October, 1984. 8 Fig, 2 Tab, 19 Ref.

Descriptors: *Groundwater management, *Model studies, Aquifers, Groundwater pollution, Linearity.

A groundwater hydraulic management model was used to identify the optimal strategy for allocating limited fresh water supplies and containing wastes in a hypothetical aquifer affected by brine contamination from surface disposal ponds. The present cost of pumping from a network of potential supply and interception wells is minimized over a five year planning period, subject to a set of hydraulic, institutional, and legal constraints. Hydraulic constraints are formulated using linear systems theory to describe drawdown and velocity variables as linear functions of supply and interception well discharge decision variables. Linear system theory as a mechanism for coupling the hydraulic behavior of an aquifer with the economic consequences of managing this behavior is an invaluable tool for identifying optimal management strategies in freshwater aquifers which are subject to localized contamination. However, the assumption of linearity that is inherent to such an approach must be validated during postoptimality analysis by inputting optimal discharges and recharges to an external flow simulation model. The resulting simulated drawdown and velocity can be compared to drawdown and velocity predicted by the quadratic programming component of the groundwater hydraulic management model. Validation of the linearity assumption is especially important to cases in which large maximum drawdowns are allowed. For this investigation, simulated and optimal drawdowns and velocities matched closely, given the probable extent of optimization and simulation round off error. (Baker-IVI)
W85-03141

## 4C. Effects On Water Of Man's Non-Water Activities

**SUBSTRATE-MEDIATED RESPONSE OF STREAM INVERTEBRATES TO DISTURBANCE,**
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W85-02818

**EFFECT OF URBANIZATION IN AN ARID REGION: FORMATION OF A PERCHED WATER TABLE THAT CAUSES ENVIRONMENTAL DAMAGES,**
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 2F.
W85-02862

**NEW GLOBAL ASSESSMENT OF THE STATUS AND TRENDS OF DESERTIFICATION,**
New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 2A.
W85-03201

## 4D. Watershed Protection

**REMOVAL OF WOODY DEBRIS MAY AFFECT STREAM CHANNEL STABILITY,**
R. E. Bilby.
Journal of Forestry, Vol. 82, No. 10, p 609-613, October, 1984. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Logging, *Forest management, *Channel erosion, *Streamflow, *Erosion control, Erosion, Sediment transport, Channel improvement, Washington, Salmon Creek.

Many western states mandate the removal of logging debris from streams in order to prevent cumulations impassable to anadromous fish. Monitoring a small western Washington stream revealed large changes in channel structure during the first high flow after cleaning. Changes in channel morphology and the movement of woody debris after logging and subsequent channel cleaning in a stream in western Washington are described. Characteristics of those pieces which remained stable after cleaning were determined. The stream in discussion was Salmon Creek, a fourth order tributary to the Chehalis River in the Coast Range of Washington. The Creek drains a watershed of about 900 ha. The 600 m section studied was unlogged prior to 1980. The major change seen on Salmon Creek as a result of channel cleaning and high flow was a reduction in the frequency of pools formed by woody debris. The alteration or removal of debris during the stream cleaning and the subsequent movement of the debris and sediment during the initial highflow after the cleaning eliminated many of the pools. Once the debris was deposited in stable locations and again began to function in control of flow, pools began to reform, as seen by the increase in pool frequency and area following the high flow seen on December 26. Unstable debris, such as tree tops or branches, which enter during logging should be removed to lessen this accumulation in barriers that cannot be surmounted by anadromous fish. An interim guide to stream cleaning is presented. (Baker-IVI)
W85-02800

**COMBATING DESERTIFICATION: EVALUATION OF PROGRESS,**
International Center for Arid and Semi-Arid Land Studies, Lubbock, TX.
H. E. Dregne.
Environmental Conservation, Vol. 11, No. 2, p 115-121, Summer, 1984. 8 Fig, 1 Tab, 11 Ref.

Descriptors: *Desertification, *Erosion, *United Nations, Evaluation, Assessment, Planning, Deci-

sion making, Erosion control, Land use, Water supply.

In 1983 the United Nations Environment Programme undertook an evaluation of the progress made in implementation of the Plan of Action to Combat Desertification since the 1977 UN Conference on Desertification. Despite all that has been accomplished the exaggerated expectations have not come close to being realized. Land degradation continues widely, even though in places dunes are being stabilized, trees planted, and there is some success in reducing salinization of irrigated land. Too little effort is directed towards field control of desertification. All of the indirect contributions to desertification control will assist in combating desertification in the field at some time in the future. Emphasis during the first seven years has been directed towards fulfilling eight of the 26 action recommendations. Those eight cover various aspects of national and land use planning, increasing agricultural production, improving water supplies, and strengthening science and technology. Practically nothing has been done to improve understanding of the socio-economic factors underlying desertification, the human factor having been almost totally ignored. A strengthening of the Desertification Branch of the UN Environment Program is essential if there is to be any widespread improvement in combating desertification. The role of the Consultative Group on Desertification Control needs to be redefined, and the coordinating role of the Interagency Working Group on Desertification must be made more effective. (Baker-IVI)
W85-03202

**POPULATION CRISIS AND DESERTIFICATION IN THE SUDANO-SAHELIAN REGION,**
United Nations Environment Programme, Nairobi (Kenya).
S. Milas.
Environmental Conservation, Vol. 11, No. 2, p 167-169, Summer, 1984. 4 Fig, 7 Ref.

Descriptors: *Desertification, *Erosion, *Farming, *Ethiopia, *Drought, *Sudano-Sahelian Region, Water demand, Erosion control, Environmental impact.

Human activities cause desertification and human action can halt it. Improved land use and farming methods with increased inputs can raise the carrying capacity of land - the number of human or animal population units that it can support on a sustained basis - thus relieving the excessive pressures that often lead to desertification. The United Nations Environment Program assessment shows that desertification can be controlled by using already tested and proven technology, and that it is cost effective to do so. World-wide, the cost of lost agricultural productivity due to desertification is some $26 thousand millions a year, while halting desertification would cost $4.5 thousand millions a year for 20 years. The principal problem causing desertification in the Sudano-Sahelian region and elsewhere in the dry tropics, is mismanagement of the land. But due to poverty, exacerbated by rapidly-increasing numbers of mouths to feed, these people often have little choice. Increased human population density, lack of appropriate technological advances, and, in many cases, adverse outside pressures, have combined to intensify stresses on the land. (Baker-IVI)
W85-03204

# 5. WATER QUALITY MANAGEMENT AND PROTECTION

## 5A. Identification Of Pollutants

**SPECIES-DEPENDENT VARIATION IN ALGAL SENSITIVITY TO CHEMICAL COMPOUNDS,**
Goeteborg Univ. (Sweden). Dept. of Botany.
H. Blanck, G. Wallin, and S.-A. Wangberg.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 339-351, August, 1984. 4 Fig, 4 Tab, 42 Ref.

Descriptors: *Phytotoxicity, *Algae, *Algal sensitivity, Water pollution effects, Pesticides, Wastewater, Detergents.

In standardized algal toxicity tests proposed for routine use, single algal species are employed to represent the algae. Under these circumstances, the species-dependent variation in sensitivity becomes crucial. Chemical compounds were tested on thirteen freshwater algal species grown in 250-micro l liquid cultures on plastic microtitration plates. The 19 compounds tested include: alamine 336, aliquat 336, copper sulfate, diuron, disodium hydrogen arsenate, glyphosphate, hydroquinone, paraquat, phenylmercury acetate, potassium dichromate, primene JM-T, SAN 9789, sodium lauryl sulfate, sodium nitrite, wastewater, tributyl phosphate, and tributyltin chloride. The species-dependent variation in algal sensitivity (EC100) may reach over three orders of magnitude, the degree of variation depending on the chemical tested. No generally sensitive or generally insensitive species could be identified. The predictive value of small algal test batteries was low. Although it did increase with size it took the presence of more than nine members in the test batteries to improve the value to 0.1. A nine-membered test battery might underestimate the sensitivity of the most susceptible algae by a factor of 0.1. A predictive value of 0.01 requires a three-membered test battery when accounting for 95% of the chemicals and a five-membered battery at the 99% confidence level. Algal test batteries, using simple test techniques, should replace single unialgal cultures in routine work. (Moore-IVI)
W85-02698

**USE OF QUANTITATIVE ANALYSIS OF URINE TO ASSESS EXPOSURE TO ASBESTOS FIBERS IN DRINKING WATER IN THE PUGET SOUND REGION,**
Washington Univ., Seattle. Dept. of Environmental Health.
E. S. Boatman, T. Merrill, A. O'Neill, L. Polissar, and J. R. Millette.
Environmental Health Perspectives, Vol. 53, p 131-139, November, 1983. 6 Fig, 4 Tab, 24 Ref. EPA contract CI790578.

Descriptors: *Everett, *Washington, *Urine, *Asbestos, *Drinking water, Fate of pollutants, Pollutant identification.

The possibility that significant numbers of asbestos fibers were present in the urine of residents of the Everett area of Washington State was investigated. Two groups of residents were used: one group had resided in the area less than 3 months; the other, more than 20 years. Tapwater in the area contained about 200 x 10 to the 6th power fibers/liter. A control group was obtained from Seattle where the tapwater asbestos fiber content was 100 times less. At no time did the asbestos content of the urine samples from Everett consistently exceed that of the control's. There was a significant difference in the asbestos content of urine samples from subjects with less than 3 yr residence times vs those with more than 20 years. Asbestos concentrations in urine samples from Everett residents as a whole did not differ significantly from that in samples from Seattle residents. Variable degrees of chrysotile contamination of control water samples and of Nuclepore membrane filters presented a problem. The data are at present inconclusive but would suggest no relationship between high concentrations of fibers in drinking water and the numbers estimated for voided urine. (Baker-IVI)
W85-02712

**ASBESTOS IN DRINKING WATER: A CANADIAN VIEW,**
Environmental Health Directorate, Ottawa (Ontario).
P. Toft, and M. E. Meek.
Environmental Health Perspectives, Vol. 53, p 177-180, November, 1983. 6 Ref.

Descriptors: *Asbestos, *Drinking water, *Canada, *Public health, Human diseases, Cancer, Epidemiology.

Because of the widespread occurrence of chrysotile asbestos in drinking water supplies in Canada, public health professionals have been faced with evaluating the potential hazards associated with the ingestion of asbestos in food and drinking water. The results of available Canadian monitoring and epidemiologic studies of asbestos in drinking water are reviewed and discussed in light of other published work. The Canadian studies provide no consistent, convincing evidence of increased cancer risks attributable to the ingestion of drinking water contaminated by asbestos, even though the observed asbestos concentrations were relatively high in several communities. Only one study, conducted in the San Francisco Bay Area, has shown evidence of increased cancer incidence associated with the ingestion of asbestos in drinking water. (Baker-IVI)
W85-02715

**SIZE AND METAL CONCENTRATION IN THE MANGROVE MUSSEL MYTELLA GUYANENSIS (MOLLUSCA: BIVALVA) FROM BAIA DE SEPETIBA, BRAZIL,**
Universidade Federal Fluminense, Niteroi (Brazil).
L. D. de Lacerda, N. R. W. Lima, W. C. Pfeiffer, and M. Fiszman.
Revista de Biologia Tropical, Vol. 31, No. 2, p 333-335, November, 1983. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Rio de Janerio, *Brazil, *Mussels, *Mangrove swamps, *Heavy metals, *Water pollution effects, Pollution indicators, Mollusks, Monitoring, Metals.

The natural variability of metal concentrations in M. guyanensis was estimated. The chosen parameter was size, as it is well correlated with most other metabolic functions and is of major concern in developing monitoring programs. The sampled area is in the mangrove swamp of Itingussu, Baia de Sepetiba, Rio de Janerio State, an area with increasing industrial activity and consequently with moderate levels of heavy metals in the aquatic environment. The analysis of metals in shells showed a significant inverse relationship for all metals, presenting a constant trend not observed in soft tissues. As the mechanisms of metal uptake and excretion in shells are slower than those of soft tissues, shells should be used as monitoring instruments. The results suggest that the relation between metal concentration and size in mollusks is a significant factor to be considered in monitoring programs. These relationships vary with species, and care should be taken in considering results obtained in species from temperate regions and those from the tropics, even when the species are closely related. (Baker-IVI)
W85-02718

**RECENT ADVANCES IN COLIFORM METHODOLOGY FOR WATER ANALYSIS,**
Montana State Univ., Bozeman. Dept. of Microbiology.
M. W. LeChevallier, and G. A. McFeters.
Journal of Environmental Health, Vol. 47, No. 1, p 5-9, July-August, 1984. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Bacteria, *Water quality control, *Water analysis, *Coliforms, *Indicator organisms, Monitoring, Water quality, Drinking water.

Indicator bacteria are used to evaluate the potability of drinking water because it would be impossible to accurately enumerate all pathogenic organisms that are transmitted by water borne routes. The effectiveness of the coliform group of bacteria as indicators of water quality is largely related to their efficiency of enumeration. Recent improvements in coliform methodologies make these indicators more sensitive and accurate measures of drinking water quality. It is important that a more general coliform definition exist so that new methods may be evaluated with a more comprehensive set of criteria. Changes in the media used for the membrane filter technique have been proposed for

the enumeration of stressed total and fecal coliforms. Steps taken in the formation of a new selective agar medium have ensured that it is selective while minimizing the inhibition of stressed coliforms. Various resuscitation techniques for fecal coliforms are becoming more widely known. New procedures for coliform verification have been proposed. In one method presumptive coliforms were tested for the presence of B-galactosidase and cytochrome oxidase. The fermentation tube (MPN lactose) technique is described. New approaches to the most probable number method of making these assays more efficient for the recovery of indicator bacteria from drinking water are described. (Baker-IVI)
W85-02722

**TENTATIVE ASSESSMENT OF WATER POLLUTION BY THE MEDAKA EGG STATIONING METHOD: AERIAL APPLICATION OF FENITROTHION EMULSION,**
Hiroshima Univ. (Japan). School of Medicine.
Y. Hiraoka, and H. Okuda.
Environmental Research, Vol. 34, p 262-267, 1984. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Bioindicators, *Water quality control, *Monitoring, *Fenitrothion, *Medaka, Fish eggs, Toxicity, Pesticides.

To determine how centrum abnormalities in medaka could be used to indicate the degree of water pollution, several rearing experiments were carried out. Medaka eggs were placed at certain points on a stream flowing from an area in which fenitrothion emulsion (organophosphorus pesticide-MEP) was being applied aerially. There was sufficient probability that the eggs were exposed to the MEP. They were brought to the lab, and reared in dechlorinated water to adulthood. The external forms and vertebral centra of each adult fish were closely observed. There was no incidence of deformity among the control and blank experiments, but in the exposure experiments, the incidence of deformed fish was 1.7 to 4.8%. The caudal peduncle of most of the deformed fish were lightly crooked in a lateral direction. The incidence of centrum-damaged fish was 11% in the control, 9% in the blank, and 34-66% in the exposure experiments. These abnormalities were deflection, shortening, and fusion of the centra. Abnormalities occurred mainly in the 29th and 30th centrum, and urostyle of medaka in the exposure experiment groups. (Baker-IVI)
W85-02726

**DETERMINATION OF ALKALINITY AND ACIDITY OF WATER BY CONDUCTOMETRIC ACID-BASE TITRATION,**
National Water Research Inst., Burlington (Ontario).
I. Sekerka, and J. F. Lechner.
Journal of the Association of Analytical Chemists, Vol. 67, No. 5, p 893-895, 1984. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Water analysis, *Titration, *Acidity, *Alkalinity, Sulfates, Phosphates, Organic compounds, Water quality control.

The determination of total alkalinity by using acid-base titration with trichloroacetic acid solution as titrant is described. Total acidity is determined by titration with ammonium hydroxide solution. Both titrations are monitored conductometrically. Performance is evaluated and compared with performance of the potentiometric titration. Automated conductometric titration is simple, fast (30s/titration), sensitive to a detection limit of 0.1 ppm calcium carbonate, and accurate. The relative error of the determination increased from about 1% at high levels to about 10% at 1 ppm calcium carbonate. The relative standard deviation of alkalinity measurements ranged from 1 to 5%; for acidity these ranges were from 1.5 to 17%. Relative standard deviation reached 33% at lower detection limits. Samples containing noncarbonate contributory components of alkalinity can be reproducibly analyzed. (Baker-IVI)
W85-02734

**PURGE AND TRAP CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF ACRYLONITRILE, CHLOROBENZENE, 1,2-DICHLOROETHANE, AND ETHYLBENZENE IN AQUEOUS SAMPLES,**
Monsanto Agricultural Products Co., St. Louis, MO. Research Dept.
J. M. Warner, and R. K. Beasley.
Analytical Chemistry, Vol. 56, No. 11, p 1953-1956, September, 1984. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Chromatography, *Organic compounds, Acrylonitrile, Chlorobenzene, Dichloroethane, Ethylbenzene.

A purge and trap method is presented for the determination of four priority pollutants in aqueous samples. Water samples are purged at 50 C with helium and the analytes are trapped on Tenax GC. The trap is thermally desorbed directly into a gas chromatograph equipped with a flame ionization detector. Instrument calibration is performed by direct injection of standard solutions in methanol through a modified purge vessel. The method was validated in the laboraory for the range of 20-500 ppb for each analyte using a 5 g aqueous sample. Average recoveries were 62%, 100%, 99%, and 92% for acrylonitrile, chlorobenzene, 1,2-dichloroethane, and ethylbenzene, respectively. Testing of the method on field samples was performed by using samples collected from various sources at an industrial site at which the four analytes were present either as raw materials or as byproducts. (Baker-IVI)
W85-02736

**DETERMINATION OF INORGANIC CARBON (TIC) IN SMALL SAMPLES WITH THE USE OF MICRO-COMPUTERS (EINSATZ VON MICRO-COMPUTERN BEI DER BESTIMMUNG VON ANORGANISCHEM KOHLENSTOFF (TIC) IN GERINGEN WASSERMENGEN),**
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
B. Merkel, and U. Ferstl.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 4, p 153-157, August, 1984. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Water analysis, *Carbon, *Computers, Inorganic carbon, Acidity, Infrared photometry.

The determination of inorganic carbon (TIC) by IR-photometry is used as an example of the use of microcomputers in water analysis. Using a simple but dependable injection device, total inorganic carbon concentrations can be measured in samples of about 30 microliters. The analog output signal of the IR-photometer, a linear function of the carbon dioxide concentration, is digitized and transfered on line to the computer while the integration of the digits is done post-run. The equilibrium distribution of the inorganic carbon species is calculated from measured total inorganic carbon and pH value. The computer output can be directed to either the screen, the printer, or the data-file. (Author's abstract)
W85-02741

**DETECTION OF ELEMENTARY SULPHUR IN FRESHWATER SEDIMENTS,**
Hajdu-Bihar County Water Canalization Works, Debrecen (Hungary).
I. Devai, C. Heim, I. Wittner, G. Devai, and Z. Dinya.
Environmental Pollution (Series B), Vol. 8, No. 2, p 155-160, 1984. 1 Tab, 16 Ref.

Descriptors: *Sulfur, *Sediments, *Lake Balaton, *River Zala, *Hungary, *Wastewater treatment facilities, *Lakes, *Rivers, *Pollutant identification, Chromatography, Spectrophotometry, Chlorinated hydrocarbons.

Chlorinated hydrocarbons in the sediments of the shallow Lake Balaton, the River Zala and two open air BMKO type sewage treatment plants were studied by gas chromatography. For the detection of chlorinated hydrocarbon contaminantion of Lake Balaton sediments, air-dry sediment samples were first used. A chromatogram indicating the presence of PCBs was characteristics of each hexane-eluate. In the case of samples from the mouth of the River Zala, however, an all-screening, large peak occurred with a 3.78 minute retention time. This peak also occurred in samples from Lake Balaton and from the open air sewage treatment plant samples. It was suggested that a great amount of elementary sulfur must be present in the sediment investigated. The sulfur peak was missing from the air-dry samples eluted in hexane, since the finely dispersed sulfur underwent slow oxidation under these conditions. An urgent need is seen to investigate the sulfur cycle, and compare these findings with the phosphorus and nitrogen cycles. (Baker-IVI)
W85-02746

**RESULTS OF INTERLABORATORY RINGTESTS CONCERNING THE DETERMINATION OF CHLOROPHYLL-A IN WATER (ERGEBNISSE EINES RINGVERSUCHES ZUR CHLOROPHYLL-A-BESTIMMUNG IM WASSER),**
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
E. A. Nusch.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 3, p 89-94, June, 1984. 6 Fig, 6 Tab, 15 Ref.

Descriptors: *Quality control, *Laboratories, *Chlorophyll a, *Chemical analysis, Ethanol, Extraction, Water analysis, Phaeopigments.

The Ethanol extraction method according to Nusch and Palme (Nusch, E. A. and Palme, G., 1975. Gas- und Wasserfach, Vol. 116, p 562-565) on which a German Standard (DIN 38412, Part 16) has been drafted, was tested tentatively in a preliminary ringtest with 6 laboratories and definitively in a ringtest with 18 laboratories participating. In spite of various difficulties in the performance (e.g. instability and inhomogenity of samples, unexperienced assistants) the method proved to be sufficiently accurate, precise and reproducible. The interlaboratory standard deviation of chlorophyll determinations in the final ringtest (3 different reconstituted and natural samples) was 5-11%. These satisfactory results confirm the previous tentative experiments which yielded standard deviations of +/- 6-10% for the chlorophyll determinations. The average variation coefficient of 226 determinations in 2 round robins with 6 different chlorophyll concentrations (20-340 micro g/l) amounts to 8%. The variation coefficients of 190 phaeopigment determinations with 6 different concentrations (8-58 micro g/l) average 27%. (Author's abstract)
W85-02755

**LIMITS OF DETERMINATION AND DETECTION OF CHLORINE, CHLORINE DIOXIDE AND CHLORITE BY THE METHOD OF PALIN (BESTIMMUNGS- UND NACHWEISGRENZEN DER METHODE VON PALIN ZUR DIFFERENTIELLEN ANALYSE VON CHLOR, CHLORDIOXID, UND CHLORIT IM TRINKWASSER),**
Rheinisch-Westfaelische Wasserwerksgesellschaft m.b.H., Mulheim an der Ruhr (Germany, F.R.).
H. Overath, and K. T. Oberem.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 3, p 99-105, June, 1984. 8 Fig, 4 Tab, 11 Ref.

Descriptors: *Chlorine dioxide, *Chlorite, *Detection limits, Chemical analysis, Water treatment, Drinking water.

Chlorine dioxide is increasingly used for disinfecting drinking water. For chlorite, an inevitable side product, the fixing of a threshold value is expected in the near future which must not be surpassed in drinking water. Palin (Palin, A. T., 1975. J. American Water Works Assoc., Vol. 67, p 32-33) developed a well known method for detecting chlorine, chlorine dioxide and chlorite simultaneously. For this analytical method the limit of determination and the limit of detection are now accessible. It

turned out that with a single test 0.10 mg/l chlorite can be quantitatively detected in the presence of chlorine dioxide and/or chlorine with a statistical probability of P = 99%. (Author's abstract)
W85-02756

**MULTIVARIATE STATISTICAL ANALYSES OF 96-HOUR SEDIMENT BIOASSAY AND CHEMISTRY DATA,**
Aqua Tech Environmental Consultants, Inc., Melmore, OH.
R. A. Laskowski-Hoke, and B. L. Prater.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 400-409, October, 1984. 3 Tab, 19 Ref.

Descriptors: *Water analysis, *Lake Michigan, *Bioassay, *Chemical analysis, *Lake sediments, Water quality, Harbors, Lakes, Multivariate analysis.

As a result of increased concern over toxic substances in freshwater sediments, renewed interest has been focused on the importance of sediment quality and sediment-organism, sediment-water column interactions. An investigation began in 1977 in five harbors of Lake Michigan to determine if relationships existed between results of chemical and bioassay analyses. The canonical correlation analyses illustrated significant relationships betwen the bioassay and various chemistry data sets. As an analytical tool, it facilitated the identification of the most important variables in each of the chemistry data sets relative to the bioassay data and confirmed the results of the univariate analyses. The multivariate analyses also illustrated that the redundancy of the bioassay data set was greater than that of each of the chemistry data sets. Although direct cause and effect relationships between mortality of test organisms and concentrations of chemical parameters are not postulated, these results add credence to the potential for such relationships. (Baker-IVI)
W85-02777

**DIFFERENTIAL RESPONSE OF MARINE ORGANISMS TO CERTAIN METAL AND AGRICHEMICAL POLLUTANTS,**
Toledo Univ., OH. Dept. of Biology.
H. H. Lee, and C. H. Xu.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 460-467, October, 1984. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Metals, *Marine animals, *Agricultural chemicals, Organic compounds, Brine shrimp, Starfish, Sea urchins, Amphioxus, Bioassay.

Oocyte maturation of the starfish, fertilization and embryogenesis of sea urchins, and the development of amphioxus and brine shrimps were used to assay the effects of several common metals and agrichemicals frequently found in the marine environment. Brine shrimp embryos were most tolerant to all the substances at the levels tested. There were no effects on their hatchability or development. The most toxic substances in affecting 1-methyladenine induction of starfish oocyte maturation were triphenyls. Cu, Mg, Ni and Zn inhibited fertilization of sea urchin eggs as evident by the absence of fertilization membrane and cleavage. The findings of the differential response of different species and stage specific response to environmental pollutants can be used in a diversity of purposes. (Baker-IVI)
W85-02783

**POTENTIOMETRIC STRIPPING ANALYSIS FOR MANGANESE(II) IN NATURAL WATERS,**
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
H. Eskilsson, and D. R. Turner.
Analytica Chimica Acta, Vol. 161, p 293-302, July, 1984. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Manganese, *Surface waters, *Drinking water, *Potentiometric stripping analysis, Potentiometers, Copper, Zinc, Gallium, Natural waters.

Potentiometric stripping analysis (p.s.a.) methods for the measurement of manganese(II) in natural waters in the concentration range of 2 nM - 30 microM are described along with the determination of total dissolved manganese following pretreatment with hydroxylamine. The method was used to measure manganese levels in nine North Atlantic water samples taken in 1981. The measurements in deaerated samples agreed well with atomic absorption spectrometry (a.a.s.) measurements, whereas lower values were generally obtained in non-deaerated samples. In contrast to the batch measurements, linear response could be obtained up to at least 30 microM manganese by the use of short deposition times. The detection limit of the flow technique was estimated to be 1.8 nM. The reproducibility of the measurements depended to some extent on the pH of the samples. Manganese was measured in a series of samples taken from the Norwegian fjord Framvaren in September of 1983. Total manganese concentrations were measured by both p.s.a. and a.a.s. after hydroxylamine treatment and the agreement was generally good, although between 20 and 30 m depth, potentiometric stripping gave significantly higher values than a.a.s. Tap water samples containing significant levels of both copper and manganese were examined. Only on the addition of 30 microM gallium nitrate were a straight calibration line and a realistic estimate of manganese concentration able to be obtained. (Baker-IVI)
W85-02798

**DERIVATIZATION OF ORGANIC AND INORGANIC N-CHLORAMINES FOR HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC ANALYSIS OF CHLORINATED WATER,**
Old Dominion Univ., Norfolk, VA. Alfriend Chemical Labs.
F. E. Scully, Jr., J. P. Yang, K. Mazina, and F. B. Daniel.
Environmental Science and Technology, Vol. 18, No. 10, p 787-792, October, 1984. 5 Fig, 25 Ref.

Descriptors: *Water analysis, *Chloramines, *Water treatment, *Chlorination, *Chromatography, Disinfection, Wastewater treatment, Reaction kinetics.

Organic and inorganic N-chloramines are converted to highly fluorescent dansyl derivatives by reaction with 5-(dimethylamino)naphthalene-1-sulfinic acid (DANSO2H). Details of the method for derivatizing dilute aqueous solutions of N-chlormaines are given along with the application of high performance liquid chromatography to the separation of mixtures of chloramine derivatives. The derivatization method is applied to the analysis of aqueous solutions of individual amines and a mixture (2 mg/L as N in each amine component) chlorinated to different Cl2/N levels and incubated for 1 hr. The chloramine concentrations measured in this manner are correlated with residual chlorine levels determined by the DPD-titrimetric method. A sample of a chlorinated municipal wastewater effluent was analyzed and found to contain both organic and inorganic N-chloramines. A dichloramine probably undergoes two successive displacements of its chlorines on reaction with DANSO2H to form its parent amine and two dansyl chloride molecules. Subsequent reaction would yield the same derivative as the corresponding monochloramine. There is good correlation between the amount of recovered dansylamide and the residual oxidant in the region of the curve where dichloramine formation becomes significant. The use of a cosolvent inhibits the hydrolysis of the intermediate sulfonyl chloride. (Baker-IVI)
W85-02807

**ORGANIC COMPOUNDS IN WATER: ANALYSIS USING COUPLED-COLUMN HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AND SOFT-IONIZATION MASS SPECTROMETRY,**
Water Research Centre, Medmenham (England). Medmenham Lab.
B. Crathorne, M. Fielding, C. P. Steel, and C. D. Watts.
Environmental Science and Technology, Vol. 18, No. 10, p 797-802, October, 1984. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Chromatography, *Water analysis, *Mass spectrometry, *Organic compounds, *Water quality control, Drinking water, Rivers, Ionization.

The use of coupled-column high-performance liquid chromatography and mass spectrometry using field desorption (FD) and fast atom bombardment (FAB) ionization for the separation and identification of organics isolated from river and drinking waters is reported. HPLC analysis of extracts of both river and drinking waters invariably results in complex chromatographs. Mass spectrometry (FD and FAB) is carried out both on HPLC fractions and on total extracts. A typical example of an FD mass spectrum obtained from an extract of a drinking water is shown. Generally FD yields only molecular ions. FAB, in general, has provided less information on total extracts than that provided by FD. Thus, FAB mass spectra of complex extracts highlight polar compounds with high surface activity, quaternary ammonium compounds. The nature of FD and FAB mass spectrometry is such that only approximate quantitative data can be readily obtained from total extracted and most HPLC fractions. Many of the nonvolatile organics identified are anthropogenic in origin and possess biological activity. (Baker-IVI)
W85-02808

**USE OF BONDED PHASE SILICA SORBENTS FOR THE SAMPLING OF PRIORITY POLLUTANTS IN WASTEWATER,**
Ford Motor Co., Dearborn, MI.
E. Chladek, and R. S. Marano.
Journal of Chromatographic Science, Vol. 22, No. 8, p 313-320, August, 1984. 7 Fig, 8 Tab, 32 Ref.

Descriptors: *Pollutants, *Wastewater analysis, Pollutant identification, Silica, Sorbents, Water quality control.

A cartridge sampling technique for priority pollutants in wastewater has been developed using bonded phase silica absorbents. This technique has been compared to the EPA Method 625 which requires liquid-liquid extraction of the wastewater. The sample matrix and the chemical/physical properties of each pollutant can play an important role in determining proper sampling and elution techniques. Spiking studies carried out on actual wastewater samples were valuable in determining techniques that maximize the recoveries of different types of pollutants and yet minimize background interferences. Once these techniques were established it was possible to apply the cartridge adsorbent method to the determination of a wide variety of priority polutants. From a practical standpoint, the cartridge adsorbent extraction method has several advantages in comparison with liquid-liquid extraction: cartridge sampling of wastewater can be undertaken in the field; very little solvent is needed for extraction; the labor, facilities and equipment required for sample preparation are greatly reduced; and the selective elution procedures yield a final eluate with fewer background interferences than are obtained by liquid-liquid extraction. (Baker-IVI)
W85-02809

**DETERMINATION OF CHLORINATED PHENOLS IN WATER, WASTEWATER, AND WASTEWATER SLUDGE BY CAPILLARY GC/ECD,**
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. S. K. Buisson, P. W. W. Kirk, and J. N. Lester.
Journal of Chromatographic Science, Vol. 22, No. 8, p 339-342, August, 1984. 1 Fig, 3 Tab, 33 Ref.

Descriptors: *Water analysis, *Phenols, *Wastewater analysis, *Pollutant identification, Chlorinated phenols, Organic compounds.

A method is described which permits the analysis of chlorinated phenols in aqueous samples at ng/l concentrations. Extraction is carried out by homogenization with dichloromethane, clean-up by sample concentration and back extraction with alkali, and derivatization for capillary gas chromatography/electron capture detection by extractive

alkylation with pentafluorobenzoyl chloride. The method is applied to municipal wastewater treatment works effluent, digested wastewater sludge, and soil leachate and the concentrations found are reported. Any method for the analysis of chlorophenols in environmental samples must overcome the problem of extraction of the polar phenols from a polar medium and coextraction of a number of possible interfering compounds. The problem of the poor resolution of pentachlorophenol in the sludge sample could be overcome by adjusting the temperature program in its final stages to hold the temperature at a lower level. This lengthens the analysis time. This method has a sensitivity and precision equal to and in some cases better than other published methods. The method retains simplicity of technique and rapid completion time even when applied to the most contaminated samples. (Baker-IVI)
W85-02810

**ELIMINATION OF AMMONIA INTERFERENCE IN THE PURGE-AND-TRAP GC DETERMINATION OF ORGANOHALOGENS IN WATER,**
Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, M. F. Mehran, R. A. Slifker, and D. L. Savoie.
Journal of Chromatographic Science, Vol. 2, No. 10, p 462-464, October, 1984. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Ammonia, *Organohalogens, *Water analysis, *Chromatography, *Trihalomethanes, Organic compounds.

A quick and reliable method for eliminating the ammonia interference during the purge-and-trap method of analysis of THMs and other organohalogen compounds is reported. The technique is used on chlorinated ground water and secondary wastewater effluents. Pasteur pipettes were used to make mini-ion exchange columns for ammonia removal as a pretreatment step prior to the standard purge-and-trap analysis. To insure adequate removal of the ammonia by ion exchange, the pH of the sample was lowered to 5 by adding KH2PO4. The precision estimates for the procedure employing the ammonia removal column were the same as for the standard purge-and-trap analytical procedure in the absence of ammonia. (Baker-IVI)
W85-02811

**SCREENING METHODS FOR SYNFUEL CHEMICALS IN AQUATIC ENVIRONMENTS,**
Tetra Tech, Inc., Lafayette, CA.
W. B. Mills, and D. B. Porcella.
Journal of Environmental Management, Vol. 18, No. 4, p 297-307, June, 1984. 2 Fig, 6 Tab, 2 Ref.

Descriptors: *Water analysis, *Synfuels, *Organic compounds, Water quality control, Model studies, Toxicants, Spills, Pollutant identification, Rivers, Lakes, Estuaries, Hydrocarbons.

Screening level procedures have been developed for computing concentrations of toxic and conventional water pollutants in surface waters. The procedures can be easily adapted to a broad variety of streams, reservoirs, and estuarine environments. Both dynamic and steady state situations can be analyzed. Synfuel chemicals are especially suited to this analysis because field data are lacking to assess the potential fate and effects of the wide variety of compounds that could enter the aquatic environment from synfuel activities. Two situations in a stream environment were evaluted: desorption from contaminated bed sediments and a spill. Results were obtained using a hand calculator and showed broad variation in behavior and persistence of the four synfuel compounds evaluated. In some cases concentrations exceeded water quality criteria for several days following a spill. Other benefits of performing the screening calculations include a quick assessment of potential ecological effects, and an analysis of potential risk to human populations. Based on the magnitude of such risks, a decision in favor of more detailed modeling can be made. Uncertainties in important processes can be analyzed quickly and conveniently. The methods are easily adapted to a variety of environmental situations or scenarios. This is not always a simple task for more complex model structures. (Baker-IVI)
W85-02812

**QUAL II MODEL,**
Universidade Nova de Lisboa (Portugal). Sanitary Engineering Group.
A. S. Camara, and C. W. Randall.
Journal of Environmental Engineering, Vol. 110, No.5, p 993-996, October, 1984. 1 Ref.

Descriptors: *Streams, *Water quality, *Model studies, Mathematical equations, Nitrates, Phosphorus, Ammonia, Water quality control, Algae.

QUAL II is a stream water quality model developed for the EPA that integrates a set of simultaneous equations over time. These equations include dispersion and advection terms and the reactions and interactions among a variety of water quality constituents including dissolved oxygen, biochemical oxygen demand, ammonia, nitrite, nitrate, phosphorus, algal biomass, coliforms and radionuclides. Attempts to apply the model have brought out some shortcomings. It is pointed out that the model contains a poor representation of the NO3, P and algae terms. Both the solution of the singularity problem and a more correct modeling of the evolution of those constituents, could be achieved by introducing non-zero coefficients on NH3 and P, in the respective differential equations. (Baker-IVI)
W85-02821

**SPECTROPHOTOMETRIC DETERMINATION OF NITRITE IN WATERS WITH 5,7-DIHYDROXY-4-IMINO-2-OXOCHROMAN,**
Shizuoka Univ., Hamamatsu (Japan). Dept. of Applied Chemistry.
M. Nakamura, T. Mazuka, and M. Yamashita.
Analytical Chemistry, Vol. 56, No. 12, p 2242-2244, October, 1984. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Nitrites, *Spectrophotometry, Water quality, Chemical analysis, Wastewater analysis.

A method is described for the rapid, sensitive, selective, and reproducible extraction and spectrophotometric determination of nitrite in water samples with 5,7-dihydroxy-4-imino-2-oxochroman which was chosen from a general investigation of various coumarins and chromans. This reagent reacts quickly with nitrite in acidic medium. The product is extracted readily into the mixed solvent of n-butylalcohol and ethyl acetate and has an absorption maximum at 361 nm. Beer's law is obeyed over the concentration range of 0.005-0.280 ppm of nitrite nitrogen. The molar absorptivity is 23200 L/mol, and Sandell sensitivity is 0.602 ng/sq cm for nitrite nitrogen. The relative standard deviation is plus or minus 0.3% for the determination of 0.105 ppm of nitrite nitrogen. The method has been used for the determination of nitrite in river, lake, waste and rain waters. (Baker-IVI)
W85-02833

**XENOBIOTIC PERTURBATION OF MICROBIAL GROWTH AS MEASURED BY CO2 UPTAKE, IN AQUATIC HETEROTROPHIC BACTERIA,**
Columbia National Fisheries Research Lab., MO.
B. T. Johnson, and V. I. Romanenko.
Journal of Great Lakes Research, Vol. 10, No. 3, p 245-250, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Bacteria, *Carbon dioxide, *Absorption, Water quality control, Monitoring, Bioassay, Environmental effects, Fisheries, Kepone, Simazine, Dilox, Mirex, Phalates.

A microbiological assay, based on the dark reaction carboxylation by heterotrophic bacteria, was developed to assess chemical-induced changes in aquatic heterotrophic bacterial populations in the laboratory and in natural waters. This simple, sensitive, reproducible C-14 radiometric assay was used to monitor changes in biosynthetic activity of naturally occurring heterotrophic bacteria stimulated with an organic nutrient and incubated with known or potential aquatic chemical contaminants. Kepone at water concentrations of more than 1.0 mg/L significantly inhibited bacterial carboxylation. Inhibition tended to follow a linear dose-response. Simazine slighty stimulated bacterial carboxylation; Dylox, mirex and di-2-ethylhexyl phthalate produced no effects. The predictive value of this assay would be enhanced by directly relating physiological activiy to bacterial biomass, and thereby, differentiating perturbation of a specific biochemical process from a general population depressant or stimulant. A specific activity perturbation index would give the environmental microbiologist a quantitative measurement to use in a predictive model for assessing the impact of xenobiotic stress on aquatic biogeochemical cycles and ultimately the fishery. (Baker-IVI)
W85-02885

**CANCER IN WILD FRESHWATER FISH POPULATIONS WITH EMPHASIS ON THE GREAT LAKES,**
Columbia National Fisheries Research Lab., MO.
P. C. Baumann.
Journal of Great Lakes Research, Vol. 10, No. 3, p 251-253, 1984. 15 Ref.

Descriptors: *Water pollution effects, *Fish, *Cancer, *Great Lakes, Carcinogens, Tumors, Fish populations, Water pollution effects, Polychlorinated biphenyls, Polynuclear aromatic hydrocarbons, Carcinogens.

Papillomas in white sucker, gonadal tumors in carp x goldfish hybrids, and thyroid hyperplasia in coho salmon seem to be widespread in occurrence throughout the Great lakes. In all cases, however, tumor incidence increases near areas contaminated by industrial effluents such as polychlorinated biphenyls, and polynuclear aromatic hydrocarbons (PAHs). Liver tumors in bullhead occur frequently at a site with large amounts of PAH in the sediment, and liver tumors in auger and walleye occur in a lake which has been a dump site for copper mine wastes. Therefore, tumor incidence in certain species of fish may be a sensitive indicator of the level of carcinogenic compounds in the environment. The Great lakes apparently contain a number of localized areas in which carcinogenic contaminants are now affecting the health of resident fish species. (Baker-IVI)
W85-02886

**INTERCOMPARISONS OF ANALYTICAL METHODOLOGY AND LABORATORY CAPABILITIES BETWEEN SOVIET AND AMERICAN LABORATORIES - 1973 AND 1977,**
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
M. D. Mullin, A. A. Matveyev, and A. M. Anikanov.
Journal of Great Lakes Research, Vol. 10. No. 3, p 254-260, 1984. 9 Tab, 8 Ref.

Descriptors: *International agreement, *Lake Baikal, *USSR, *United States, *Water analysis, Quality control, Sediments.

A comparison of analytical methodologies and laboratory capabilities was undertaken as part of the cooperative scientific efforts between the US and the USSR on aquatic ecosystems. The samples exchanged between participating laboratories in the two countries included water samples from Lake Baikal, and standard reference samples from the US EPA. From the results of the intercalibration of samples performed, two conclusions were drawn relative to a comparison of method of analysis: the first characterizes the satisfactory agreement of analytical methods which can be used as a basis for further joint studies in areas where hydrochemical information is used; the second relates to widely different results which were obtained and explains these differences as due to the inexperience of the Baikal Expedition in the determination of very high concentrations and the time increments involved in the exchange of samples between the two countries. (Baker-IVI)
W85-02887

**COMBINATION OF CONTINUOUS MODE LIQUID-LIQUID EXTRACTION WITH COUPLED GC-MS FOR THE ANALYSIS OF PESTICIDES IN WATER (COMBINAISON D'UNE CELLULE D'EXTRACTION LIQUIDE-LIQUIDE EN CONTINU ET D'UN COUPLAGE CG-SM EN VUE DE L'ANALYSE DES PESTICIDES DANS LES EAUX),**

Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
A. Bruchet, L. Cognet, and J. Mallevialle.

Water Research, Vol. 18, No. 11, p 1401-1409, 1984. 10 Fig, 4 Tab, 13 Ref.

Descriptors: *Pesticides, *Chemical analysis, *Liquid-liquid extraction, *Gas chromatography, *Mass spectroscopy, Extraction, Chromatography, Instrumentation, Fragmentometry, Composite samples.

The occurrence of synthetic organic chemicals in drinking water supplies has prompted the European Economic Community to establish standards for pesticides. Currently, the limit on total pesticides is 500 ng/l with no individual pesticides to exceed 100 ng/l. The variability of pesticides, both in concentration and composition, indicates that composite rather than grab samples are desirable for analysis of the water quality. Furthermore, the variability in composition makes a broad spectrum analysis preferable to individual compound analysis so that many compounds can be analyzed simultaneously. Although composite broad spectrum samples are desirable from a collection point of view, the occurrence of many pesticides in one sample presents a problem for individual compound quantification and identificaton. For this reason, gas chromatography (GC) is used to separate the compounds and mass spectrometry (MS) is used to identify and quantify the compounds. Coupled GS-MS avoids interferences which may occur in GC by using a separate method (other than retention time or volume) to identify compounds. This research compared liquid-liquid extraction (LLE) in the batch and continuous mode. The LLE process is accomplished in a continuous mode by mixing the water and solvent in a coil, allowing the water and solvent to separate in a quiescent decantation cell, then recirculating the solvent by a separate distillation cell while the water goes to waste. Tap water was spiked with pesticides at 10, 50 and 100 ng/l. Extraction efficiency was compared at each of the three spiking concentrations. The extracts were analyzed on GC-MS using a moving needle injection technique to enhance sensitivity. The identification and quantification of compounds were accomplished by MS using fragmentometry technique which enhance sensitivity of the analysis. The results indicate that continuous LLE will recover an average of 75% (+/- 14%) of the pesticides in the 10-100 ng/l range recoverable by batch LLE. There was no significant difference in recovery for structurally different pesticides (chlorinated, nitrogenous or phosphoric) as all fell in the 75 +/- 14% range. Eighteen pesticides were identified and quantified by the GC-MS in a 25 min analysis. This demonstrates that the continuous LLE technique can be used to automate collection of composite samples if the reduction in extraction efficiency is taken into account. The continuous LLE can handle much larger volumes of water than the batch LLE. Composite samples can be continuously collected over time, a sampling regime not possible with batch LLE. This technique when coupled with GC-MS can be used to identify and quantify pesticides at the ng/l level and can be applied routinely for analysis of pesticides at approximately the same price as individual pesticides analysis. (Author's abstract)
W85-02913

**GEL PERMEATION CHROMATOGRAPHY OF HUMIC ACID; PROBLEMS ASSOCIATED WITH SEPHADEX GEL,**

South Australia Engineering and Water Supply Dept., Salisbury. State Water Labs.
P. T. Hine, and D. B. Bursill.

Water Research, Vol. 18, No. 11, p 1461-1465, 1984. 4 Fig, 26 Ref.

Descriptors: *Water analysis, *Gel permeation chromatography, *Humic acid, *Molecular structure, Evaluation, Chromatography, Natural waters.

Gel permeation chromatography with Sephadex gels has become a widely used method for analyzing naturally occurring organic materials in raw and treated waters. Several problems in the interpretation of molecular weight profiles from these gels have become apparent and the usefulness of the method is questioned. The validity of gel permeation is dependent on the extent to which gel-solute interactions other than purely size exclusion are operating. If alternative mechanisms interfere significantly then the fractionation is of little practical value. The effects of altering sample or eluant composition produced changes to Sephadex gel permeation chromatograms which were not open to unambiguous interpretation. Ionic strength and gel-solute interactions, either charge induced exclusions or adsorption can effect the transport of humic materials unpredictably through a gel column leading to incorrect molecular weight profiles. As a result, gel permeation chromatograhy using Sephadex gels is of limited value in the analysis and comparison of humic materials in natural waters. (Baker-IVI)
W85-02920

**THORIUM 230 DETERMINATION IN POLLUTED LAKE WATER - A STUDY OF INTERFERENCES,**

Carleton Univ., Ottawa (Ontario). Dept. of Chemistry.
I. G. De Jong, and D. R. Wiles.

Water, Air, and Soil Pollution, Vol. 23, No. 2, p 197-208, August, 1984. 5 Fig, 6 Tab, 16 Ref.

Descriptors: *Thorium, *Radioisotopes, *Lakes, *Nero Lake, *Saskatchewan, *Chemical analysis, Isotope studies, Chemical precipitation, Radium, Barium sulfate, Lanthanum, Uranium tailings.

One of the most attractive methods available for radiochemical determination of thorium isotopes involves coprecipitation of Th with BaSO4 in the presence of added K ions (Sill, C.W. and C.P. Willis, 1964. Anal. Chem., Vol. 36, p 622). The chemical recovery of Th in uncomplicated samples is usually nearly complete (90-95%) and is determined by measuring the recovery of a Th-234 spike added early in the analytical procedure. Too low a recovery causes diminished precision and may lead to cross-contamination of other isolated fractions by the unrecovered Th. Some environmental samples contain substances which cause the recovery of the Th-234 tracer, and presumably all the Th, to be extremely low - in some cases as low as 5%. The decreased recovery effect was illustrated by results obtained on water from Nero Lake, a uranium mine tailings dumping area in northern Saskatchewan. The effect was not caused primarily by volatile components, organic components, or silicates. Attempts to duplicate the effect using synthetic lake water were not successful; the lowest value of percent recovery for the synthetic water was 41.6% compared to 4.5% for undiluted lake water. The effect is very complex, with a lot of interraction among ions. The environmentally significant aspect of this work is to show that this method for sequestering traces of Th cannot be reliably used on water with a high ionic content. An alternative method was developed which avoids the problems of interference in the coprecipitation of Th by BaSO4; this method uses La(+3) to prevent coprecipitation, allowing Ra to precipitate uncontaminated. The same La functions subsequently as a carrier for Th. (Collier-IVI)
W85-02927

**ELUTION OF ENTERIC VIRUSES FROM MISSISSIPPI ESTUARINE SEDIMENTS WITH LECITHIN-SUPPLEMENTED ELUENTS,**

University of Southern Mississippi, Hattiesburg. Dept. of Biological Sciences.
R. A. Johnson, R. D. Ellender, and S.-C. Tsai.

Applied and Environmental Microbiology, Vol. 48, No. 3, p 581-585, September, 1984. 2 Fig, 8 Tab, 15 Ref. NOAA grant NA 81AA-D-00050.

Descriptors: *Enteroviruses, *Estuarine sediments, *Estuaries, *Lecithin, *Sediments, Coxsackie viruses, Echovirus, Poliovirus, Casein, Clay content.

Isoelectric casein supplemented with lecithin was tested for its ability to recover enteric viruses from estuarine sediments of varied sand, silt, and clay composition. Recoveries were higher when lecithin was incorporated into an eluent as compared with trials with only the casein solution. Semipurified soybean lecithin (3%) allowed the highest overall recovery of virus from all sediments tested; crude soybean lecithin produced the lowest recovery. A difference in the percentage of virus able to be recovered from a sediment was related to the percentage of clay in the sample. Correlational statistics indicated a trend toward lower virus recovery as the clay composition of a sediment increased. Virus adsorption to the four sediments tested revealed differences between poliovirus, coxsackievirus, and echovirus adsorption that could not be explained on the basis of the clay content of a sediment. (Author's abstract)
W85-02934

**COLIPHAGES AS INDICATORS OF ENTEROVIRUSES,**

Health Effects Research Lab., Cincinnati, OH.
R. E. Stetler.

Applied and Environmental Microbiology, Vol. 48, No. 3, p 668-670, September, 1984. 3 Tab, 18 Ref.

Descriptors: *Coliphages, *Enteroviruses, *Bioindicators, Bacterial indicators, Viruses, Coliforms, Streptococci.

Coliphages were monitored in conjuction with indicator bacteria and enteroviruses in a drinking-water plant modified to reduce trihalomethane production. Coliphages could be detected in the source water by direct inoculation, and sufficient coliphages were detected in enterovirus concentrates to permit following the coliphage levels through different water treatment processes. The recovery efficiency by different filter types ranged from 1 to 53%. Statistical analysis of the data indicated that enterovirus isolates were better correlated with coliphages than with total coliforms, fecal coliforms, fecal streptococci, or standard plate count organisms. Coliphages were not detected in finished water. (Author's abstract)
W85-02936

**COMPARISON OF METHODS OF ENUMERATING COLIFORMS AFTER UV DISINFECTION,**

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls, J. C. H. Chang, S. F. Ossoff, and J. D. Johnson.

Applied and Environmental Microbiology, Vol. 48, No. 4, p 699-701, October, 1984. 1 Fig, 1 Tab, 25 Ref. EPA grants R809593010 and R804770010.

Descriptors: *Coliforms, *Ultraviolet radiation, *Disinfection, *Bacterial analysis, Most probable number test, Membrane filtration, Wastewater analysis, Wastewater treatment.

In view of the differences that have been found between the most-probable-number and membrane filtration methods for the recovery of coliforms from chlorinated samples, the survival of total and fecal coliforms in UV-irradiated effluent samples, as tested by the most-probable-number and standard single-step membrane filtration methods, was compared. There were no significant differences in the survival of total and fecal coliforms, as tested by the two methods. In a separate set of experiments comparing total and fecal coliform survival, as tested by the most-probable-number method, only a very small but statistically significant difference of 0.1 log survival units was found. For UV-disinfected wastewater effluents, standard one-step membrane filtration procedures are comparable to standard most-probable-number procedures. (Author's abstract)
W85-02938

**ANALYSIS OF SAMPLE PREPARATION PROCEDURES FOR ENUMERATING FECAL COLIFORMS IN COARSE SOUTHWESTERN**

U.S. BOTTOM SEDIMENTS BY THE MOST-PROBABLE-NUMBER METHOD,
Arizona Univ., Tucson. School of Renewable Natural Resources.
J. D. Doyle, B. Tunnicliff, R. E. Kramer, and S. K. Brickler.
Applied and Environmental Microbiology, Vol. 48, No. 4, p 881-883, October, 1984. 1 Fig, 19 Ref.
USDA Forest Service grant RM-81-161-GR.

Descriptors: *Coliforms, *Coarse sediments, *Most probable number test, *Bottom sediments, Bacteria, Saguaro Lake, Arizona, Sediments, Bacterial analysis.

The determination of bacteria densities in aquatic sediments generally requires that a dilution-mixing treatment be used before enumeration of organisms by the most-probable-number fermentation tube method can be done. Differential sediment and organism settling rates may, however, influence the distribution of the microbial population after the dilution-mixing process, resulting in biased bacterial density estimates. For standardization of sample preparation procedures, the influence of settling by suspended sediments on the fecal coliform distribution in a mixing vessel was examined. This was accomplish with both inoculated (Escherichia coli) and raw, uninoculated freshwater sediments from Saguaro Lake, Ariz. Both test sediments were coarse (> 90% gravel and sand). Coarse sediments are typical of southwestern U.S. lakes. The distribution of fecal coliforms, as determined by the most-probable-number method, was not significantly influenced by sediment settling and remained homogenous over a 16-min postmix period. The technique developed for coarse sediments may be useful for standardizing sample preparation techniques for other sediment types. (Author's abstract)
W85-02942

BIODEGRADATION OF 4-NITROPHENOL IN STANDARDIZED AQUATIC DEGRADATION TESTS,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5B.
W85-02944

SIMPLE ALGORITHM FOR ON-LINE PREDICTION OF BOD5 BY A MICROPROCESSOR-BASED SYSTEM,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
R. Raviv, and S. Ben-Yaakov.
Biotechnology and Bioengineering, Vol. 26, No. 10, p 1239-1244, October, 1984. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Biological oxygen demand, *Computers, *Algorithms, Mathematical models, Automation, Water analysis, Dissolved oxygen.

The use of a microcomputer was investigated as an aid in the more rapid determination of BOD5. This can be accomplished if the DO consumption during the BOD5 incubation period is approximated by a mathematical model which can then be used to predict DO concentration after five days from the initial stage of the process. The on-line estimation and prediction algorithm, which assumes first order kinetics, was simulated on a CBM 3032 (Commodore) microcomputer programmed in BASIC to execute the data processing computation. Test runs on synthetic and experimentally derived raw data suggest that BOD5 can be predicted to within 15% in ca. 36 h. The first few hours of BOD incubation can not be used for BOD5 prediction because there are a number of phases before the DO consumption becomes regular. The method can be improved by filtering out, via a digital filter, noise from the raw data. The suggested algorithm does not require elaborate computations or large data storage and can therefore be implemented on a low-cost microcomputer for fast on-line determination of BOD5. (Collier-IVI)
W85-02951

CONSOLIDATION OF A STREAM QUALITY MONITORING NETWORK,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W85-02973

USING HEAT CAPACITY MAPPING MISSION (HCMM) DATA TO ASSESS LAKE WATER QUALITY,
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
W. Miller, and A. Rango.
Water Resources Bulletin, Vol. 20, No. 4, p 493-501, August, 1984. 8 Fig, 11 Tab, 18 Ref.

Descriptors: *Satellite technology, *Lakes, *Water quality, *Reflectivity, *Infrared imagery, Remote sensing, Algae, Phytoplankton, Thermal properties, Utah Lake, Utah.

A water quality investigation on Utah Lake was conducted during the same time period that the Heat Capacity Mapping Mission (HCMM) satellite was collecting thermal infrared and reflectivity data. Relationships were established and evaluated among HCMM data and lake water quality parameters. Although remotely sensed reflective data has been previously utilized, this study was unique in that thermal emitted data were also correlated to algae concentrations and other indicators. Standard statistical evaluations were made along with utilization of color graphics techniques to identify and plot relationships. The emitted thermal energy was found to have high positive correlations with net algal concentrations and with the predominant species, Aphanizomenon flos-aquae, a blue-green alga. No continuous correlation was found for a less abundant red pigment phytoplankton, Ceratium hirundinella. Similar trends, though for negative correlations, were shown for reflectivity data and algal concentrations throughout the spring and summer. Coincidence of areas of warmer emitted energy and darker reflected energy on colorgraphics displays clearly indicate lake areas of high algal concentrations. Night thermal data display a strong negative correlation with algal concentration, opposite to day thermal data. Color graphics of warmer day emitted energy and cooler night emitted energy further verify areas of high algal concentrations. (Author's abstract)
W85-02975

MULTIVARIATE ANALYSIS OF SPECIES COMPOSITION OF SHORE-ZONE FISH ASSEMBLAGES FOUND IN LONG ISLAND SOUND,
Northeast Utilities Environmental Lab., Waterford, CT.
L. E. Bireley.
Estuaries, Vol. 7, No. 3, p 242-247, September, 1984. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Multivariate analysis, *Species composition, *Fish, *Millstone Point, *Connecticut, *Long Island Sound, Nuclear powerplants, Environmental effects, Water pollution effects.

Monitoring programs for the Millstone Nuclear Power Station were established as early as 1969 to assess the impact of operation and construction of the nuclear poser plants at Millstone Point, Connecticut, on the indigenous fish populations in nearby Long Island Sound. In the period 1969-1981 representatives of 41 taxonomic groups were found in the shore-zone finfish assemblage near Millstone Point. A nested design was used to analyze the variance of the proportions or percent species composition. The relative importance of five selected shore-zone species was found to be significantly influenced by both station and season within a year. Also included in the nested ANOVA model were effects due to period of plant operation (no units operating, one unit operating and two unit< operating) and year within period. Neither of these two effects was found to influence the percent species composition. The percent species composition of finfish did not change concurrent with startup of either Unit 1 or 2 at the Millstone Nuclear Power Station. A nested ANOVA of percent species composition can be useful for detecting changes in assemblages of finfish species over time and space. (Moore-IVI)
W85-02997

ARSENIC IN NOVA SCOTIAN GROUNDWATER,
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Centre.
J. C. Meranger, and K. S. Subramanian.
Science of the Total Environment, Vol. 39, No. 1/2, p 49-55, October, 1984. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water analysis, *Arsenic, *Pollutant identification, *Nova Scotia, Wells, Water quality control, Drinking water, Atomic absorption spectrometry.

The concentration of total soluble inorganic arsenic was measured in duplicate well water samples of 94 residents in Halifax County, Nova Scotia. The total arsenic content of the water samples was determined using two methods: (i) ammonium pyrrolidinedithiocarbamate-methyl isobutyl ketone graphite-furnace atomic-absorption spectrometry and (ii) automated hydride-evolution electrothermal atomization atomic absorption spectrophotometry. The good agreement obtained with each method clearly suggests that both procedures can be used to determine the total soluble inorganic arsenic content of these contaminated ground water samples. While the number of samples analyzed for each community in the study was not exhaustive, the values do indicate that the well waters in these communities are contaminated with arsenic. In at least 10% of the total number of samples (94) analyzed, the contamination level was approximately ten times the maximum acceptable limit of 50 ng/ml, and in 23% of the total number of samples analyzed, it is approximately five times the permissible limit. (Baker-IVI)
W85-03032

PERSONAL EXPOSURE TO VOLATILE ORGANIC COMPOUNDS; I. DIRECT MEASUREMENTS IN BREATHING-ZONE AIR, DRINKING WATER, FOOD, AND EXHALED BREATH,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
L. A. Wallace, E. Pellizzari, T. Hartwell, M. Rosenzweig, and M. Erickson.
Environmental Research, Vol. 35, No. 1, p 293-319, October, 1984. 10 Fig, 11 Tab, 19 Ref.

Descriptors: *Volatile organic compounds, *Pollutant identification, *Bayonne, *Elisabeth, *New Jersey, *Research Triangle Park, *North Carolina, Drinking water, Organic compounds, Estimating.

Individual exposures to about a dozen volatile organic compounds in air and drinking water were measured for nine volunteers in Bayonne and Elizabeth, New Jersey and from three volunteers in Research Triangle Park, North Carolina during three 3-day visits over the 6 month period. Breath samples were also collected from all subjects on each visit. About 230 personal air samples, 170 drinking water samples, 6 breath samples, and 4 food samples were analyzed for the target chemicals. Six of the target compounds were found in more than half of the air and breath samples, but seldom or never in food or water. Two compounds were transmitted primarily through drinking water or beverages. None was transmitted primarily through food. Two target compounds (vinyl chloride and 1,1,2-trichloroethane) were virtually never found. Median concentrations in air and breath were usually in the 1-10 micro g/cu m range, but air concentrations were highly variable, with maxima exceeding 100 micro g/cu m for five chemicals. Little day-to-day or person-to-person varability within a given geographic area was noted for trihalomethanes in drinking water, but a strong seasonal component was present, with summer values much greater than winter values. Beverages appeared to be an important route of exposure for chloroform and bromodichloromethane. Mean daily intakes of the four most prevalent chemicals were conservatively estimated to range from about 50 to 1000 micro g/day for 1,1,1-

trichloroethane, 25 to 600 micro g/day for tetrachloroethylene, 10 to 300 micro g/day for trichloroethylene, and 140 to 370 micro g/day for chloroform. (Baker-IVI)
W85-03041

**ACUTE TOXICITY OF AMMONIA AND COPPER TO THE GASTROPOD POTAMOPYRGUS JENKINSI (SMITH),**
Aston Univ., Birmingham (England).
A. J. Watton, and H. A. Hawkes.
Environmental Pollution (Series A), Vol. 36, No. 1, p 17-29, 1984. 1 Fig, 5 Tab, 29 Ref.

Descriptors: *Ammonia, *Copper, *Bioindicators, *Snails, Mollusks, Toxicity, Water pollution effects, Growth stages.

Acute toxicity tests (96 hr) were made using a flow-through system to determine the toxicity of ammonia and copper to Potamopyrgus jenkinsi. Both lethal and sub-lethal responses were monitored for three different age groups of snail; juvenile, prime adult and senescent. Of these three stages, the juveniles were least tolerant and the prime adults most tolerant to un-ionized ammonia. Juvenile snails were also generally less tolerant to copper than the adults. Whereas there was a marked difference between the LC50 and EC50 values for both prime and senescent adult snails, the difference between these values for juvenile snails was relatively small. Potamopyrgus jenkinsi was relatively intolerant of both ammonia and copper compared with other invertebrate taxa reported in the literature. Potamopyrgus jenkinsi could be a valuable indicator species for these pollutants. (Baker-IVI)
W85-03042

**UPTAKE AND METABOLISM BY GOLDFISH CARASSIUS AURATUS OF PENTACHLORO-2-(CHLOROMETHYL SULPHONAMIDO)DIPHENYL ETHER (6-PCSD), THE MAJOR COMPONENT AND ACTIVE INGREDIENT OF THE MOTH-PROOFING AGENT, EULAN WA NEW,**
Stirling Univ. (Scotland). Dept. of Biology.
A. Machon, M. J. North, and N. C. Price.
Environmental Pollution (Series A), Vol. 36, No. 3, p 271-281, 1984. 6 Fig, 1 Tab, 9 Ref. Natural Environmental Research Council grant CR3/4129.

Descriptors: *Insecticides, *Pentachlorophenyl ethers, *Mothproofing agents, *Pollutant identification, *Chemical analysis, Industrial wastes, Fish, Water pollution effects, Fate of pollutants, Organic compounds, Chromatography.

High performance liquid chromatography was routinely used for the analysis of PCSD and and its metabolite, pentachloro-2-aminodiphenyl ether (5-PAD) in fish tissue in preference to the alternative gas-liquid chromatography-electron capture detector method. In the latter method, methylation is needed prior to analysis in order to stabilize thermolabile PCSD components. By contrast, no derivatization is needed with HPLC. Tissue coextractants absorbing at 230 nm interfere with the determination of PCSD by HPLC and, to remove these coextractants, the published tissue extract clean up procedure has been modified. These coextractants can be removed from the 6-PCSD by selective elution of the latter with methanol prior to acidification of the column. A simplified elution procedure was developed consisting of elution with 25 ml MTBE to remove PADs selectively, followed by elution with 25 ml methanol to remove PCSDs selectively. The coextractants could then be removed by elution with 10 ml MTBE following acidification of the column. This procedure is demonstrated for a liver sample taken from a goldfish dosed with 6-PCSD for 2 hr. (Baker-IVI)
W85-03048

**ASSESSING HAZARDOUS WASTE PROBLEMS,**
Nevada Univ., Reno.
R. B. Evans, and G. E. Schweitzer.
Environmental Science and Technology, Vol. 18, No. 11, p 330A-339A, November, 1984. 8 Fig, 1 Tab.

Descriptors: *Path of pollutants, *Leaching, *Groundwater pollution, Hazardous materials, Waste disposal, Plumes, Remote sensing, Computers.

Relatively inexpensive methods for delineating subsurface features near hazardous waste sites are needed. During the past 10 years the extensive development of remote-sensing geophysical equipment including field methods, analytical techniques, and associated computer processing, has greatly improved the ability to characterize hazardous waste sites. The use of seismic refraction and resistivity to investigate a subsurface geologic structure is illustrated. A second example is offered using ground-penetrating, electromagnetic induction, and magnetic surveys to locate and estimate the amount of buried wastes. Resistivity surveys have been conducted to map a landfill leachate plume. Electromagnetic induction has aided in the choice of locations of monitoring wells that were used to map another contaminant plume. While in the past most geophysical methods for plume detection have been applied to inorganic contaminants, such as chlorides and sulfates, in groundwater, attention is now being turned to the detection of organics. (Baker-IVI)
W85-03054

**HYDROCARBON AND AZAARENE MARKERS OF COAL TRANSPORT TO AQUATIC SEDIMENTS,**
Tetra Tech, Inc., Bellevue, WA.
R. C. Barrick, E. T. Furlong, and R. Carpenter.
Environmental Science and Technology, Vol. 18, No. 11, p 846-854, November, 1984. 4 Fig, 2 Tab, 38 Ref. EPA/DOE contract DE-AT06-76-EV-70040 and DOE contract DE-AT06-76-EV-7002.

Descriptors: *Coal, *Azaarenes, *Hydrocarbons, *Washington, Sediments, Minerals, Drainage basins, Erosion, Coal mining, Pollutant identification, Water pollution sources.

Hydrocarbons and azaarenes in 16 Western Washington coals display considerable compositional change over a vitrinite reflectance range of 0.34-3.5% Ro. None exhibit an unresolved complex mixture in aliphatic extracts common to many petroleums as well as urban residues in the Puget Sound region and so are distinguished easily. Complex azaarene compositions are found in all but the lowest and highest ranked coals. A decrease in two-ring relative to three-ring azaarene dominance occurs with increasing reflectance, and the overall azaarene fingerprint is a useful parameter in distinguishing coals of varying rank. Lipid extracts from bulk marine sediments collected near the Puyallup River delta and coal particles seived from a sediment core collected at the same site display similar azaarene fingerprints and contain hydrocarbon suites in similar relative amounts as some coals within the adjacent drainage basin. Dominant coal components include pristane, C19 and C20 tricyclic diterpanes, retene, methylated chrysenes and picenes, tetrahydrochrysenes, hydropicenes, and either 1- or 3-methylphenanthrene relative to other methyphenanthrenes. Molecular markers thus demonstrate the transport of specific local coals to aquatic sediments in adjacent drainage basins resulting from erosion and mining activity. (Baker-IVI)
W85-03056

**INTEGRATED GROUND WATER MONITORING PROGRAM USING MULTILEVEL GAS-DRIVEN SAMPLERS AND CONVENTIONAL MONITORING WELLS,**
NUS Corp., Pittsburgh, PA.
A. Nazar, J. Prieur, and D. Threlfall.
Ground Water Monitoring Review, Vol. 4, No. 4, p 43-47, Fall, 1984. 4 Fig.

Descriptors: *Monitoring, *Water sampling, *Groundwater pollution, Water quality control, Hazardous materials, Hazardous waste sites.

A comparison was made between hydrogeologic and ground water quality data obtained from a gas-driven multilevel sampler system and a polyvinyl chloride monitoring well nest with the same aquifer communication intervals. The study was conducted at an eight-acre uncontrolled hazardous waste site, located in an alluvial valley composed of about 40 ft of alluvium overlying shale bedrock. There were several advantages of the multilevel gas-driven sampling system including the ability to obtain vertical point contamination concentrations; less purge water to collect and store vs. bailing or pumping; and less potential personnel dermal contact with the ground water during the sampling procedure. Gas-driven multilevel samplers become more cost effective with depth compared to conventional wells due to reduced drilling and materials costs. The primary disadvantage of the multilevel gas driven sampling system observed during the program was the volume of sample obtained during each purge of the system. This becomes critical when large sample volumes are required from each monitoring point. Both types of monitoring devices were useful during this project. Selection of the type of monitoring equipment to be used during other investigations should be based upon regulatory requirements; cost constraints; the need for specific data on vertical contaminant variability with depth within a plume; the number of chemical parameters and the amount of sample required for laboratory analysis; and the need for aquifer testing after the monitoring system is in place. (Baker-IVI)
W85-03173

**SUCTION SIDE SAMPLE CATCHER IN GROUND WATER QUALITY SAMPLING,**
McLaren Environmental Engineering, Inc., Sacramento, CA.
R. Armstrong, and F. R. McLaren.
Ground Water Monitoring Review, Vol. 4, No. 4, p 48-53, Fall, 1984. 5 Fig, 3 Tab.

Descriptors: *Water sampling, *Water quality control, *Groundwater analysis, Water analysis, Water pollution control.

The construction and operational details of a suction side sample collector (SSSC) are described as it is fitted to a submersible pump with packer for use in a 6 inch cased borehole, an air lift pump with packer for use in a 1 inch or 2.5 inch cased borehole, a bladder pump for use in a casing of 2 inch or greater diameter, and a jet pump with packer for use in a 2 inch cased borehole. The SSSC is demonstrated to be superior to other methods of collecting volatile organic chemical samples owing to its freedom from contamination by the pump delivery line and to its mode of collecting the sample from a position in the well remote from disturbance by the pumping technique. Reproducibility of samples collected with the SSSC was confirmed by replicate sampling with the device. (Baker-IV)
W85-03174

**UTILIZATION OF SHALLOW GEOPHYSICAL SENSING AT TWO ABANDONED MUNICIPAL/INDUSTRIAL WASTE LANDFILL ON THE MISSOURI RIVER FLOODPLAIN,**
Ecology and Environment, Inc., Shawnee Mission, KS.
R. J. Rudy, and J. A. Csoile.
Ground Water Monitoring Review, Vol. 4, No. 4, p 57-65, Fall, 1984. 17 Fig, 3 Tab, 6 Ref. US EPA Contract No. 68-01-6692.

Descriptors: *Landfills, *Hazardous materials, *Water pollution sources, *Groundwater pollution, *Missouri River, Floodplains, Groundwater flow.

An effective technique to initially characterize ground water contamination at two abandoned hazardous waste landfills along the Missouri River in northwestern Missouri involved a combination of electrical resistivity and electromagnetic conductivity methods. Resistivity was used to obtain soundings of the alluvium by using a modified Wenner array and to corroborate shallow electromagnetic conductivity measurements by using short Wenner array electrode spacings. Upon confirmation of similar measurements of the upper soils for the two methods, numerous electromag-

netic conductivity traverses were made at each landfill site. The data generated from these surveys were graphed and contoured to delineate anomalous areas. Based on the geophysical study, a ground water monitoring well network was then designed for each landfill. A minimal number of wells were required to initially characterize the ground water quality at these two sites. In general, analysis of water samples from these wells displayed good correlation with the geophysical results. (Baker-IVI)
W85-03175

**SPATIAL MAPPING OF CONDUCTIVE GROUND WATER CONTAMINATION WITH ELECTROMAGNETIC INDUCTION,**
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
D. D. Weber, J. F. Scholl, D. J. LeBrecque, E. G. Walther, and R. B. Evans.
Ground Water Monitoring Review, Vol. 4, No. 4, p 70-77, Fall, 1984. 12 Fig, 3 Ref.

Descriptors: *Groundwater, *Water quality control, *Water analysis, *Monitoring, Groundwater pollution, Henderson, Nevada.

A statistical technique is described which combines electromagnetic induction (EMI) survey data with hydrogeological data to reduce the effects of spatial variation of hydrogeological parameters and cultural interference. The product is a contour map of aquifer conductivity over the target area. The primary tools used are computer interpolation of spatially distributed data and one-dimensional modeling of EMI data. The method can be described as a pseudo three-dimensional statistical method, i.e. two-dimensional lateral averaging and one-dimensional EMI modeling. The name of the method is Aquicon, for aquifer conductivity. A conductive contaminant plume at Henderson, Nevada, was used to develop and test this method. With Aquicon, a plume can be identified in an area having a highly variable aquifer thickness, aquifer depth and cultural interference. One of the two plumes identified could possibly have been identified using only the contoured raw data, but the second would not have been so identified. (Baker-IVI)
W85-03177

## 5B. Sources Of Pollution

**ENVIRONMENTAL MODEL SEGMENT APPROACH FOR ESTIMATING POTENTIAL ENVIRONMENTAL CONCENTRATIONS, I. THE MODEL,**
Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
R. Frische, W. Klopffer, G. Rippen, and K. O. Gunther.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 352-362, August, 1984. 1 Fig, 13 Ref.

Descriptors: *Environmental Model Segment, *Fate of pollutants, *Path of pollutants, Water pollution effects, Model studies, Ecosystems.

Other than in the case of the distribution of persistent substances which which may approach the global equilibrium, the fate of less persistent compounds is highly dependent on the path of their penetration into the environment. The environmental effects caused by less persistent substances are only local or regional (close to the emission source), but not ubiquitous. Persistent substances may also cause effects here if they occur in relatively high concentrations. Such exposure concentrations can not be estimated by means of a global model assuming equilibrium. The Environmental Model Segment Approach (EMSA) was developed to obtain from the physical, chemical, and biological environment as a whole (the earth with air, water, land, and organisms) a practical environmental model for the evaluation of regionally effective environmental hazards. The basic concept underlying this model is that the globe is thought to be divided into a large number of segments. If hazardous effects of a chemical exist, they occur at least in one of these spatially localized segments with defined constituents, either because here the concentration of the chemical has it maximum value or because this segment contains contains the most sensitive species or ecosystem. The originally single segments of the have been combined in one Environmental Model Segment. This model segment contains all constituents relevant for the potentially hazardous substance under consideration. (Moore-IVI)
W85-02699

**ENVIRONMENTAL MODEL SEGMENT APPROACH FOR ESTIMATING POTENTIAL ENVIRONMENTAL CONCENTRATIONS, II. APPLICATION OF THE MODEL TO P-DICHLOROBENZENE AND TRICHLOROETHENE,**
Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
G. Rippen, W. Klopffer, R. Frische, and K.-O. Gunther.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 363-377, August, 1984. 7 Tab, 37 Ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Environmental Model Segment, *Dichlorobenzene, *Trichloroethene, Chlorinated hydrocarbons, Air pollution, Water pollution, Decomposition, Model studies.

The Environmental Model Segment Approach (EMSA) was developed to assess the regional environmental impact of chemicals. To assess exposure concentrations by means of the model, it is only necessary to have a few data on production and use patterns and of the distribution coefficients of compartmentalization between the environmental media, and at least one first-order rate constant for a relevant degradation mechanism. To examine the reliability of the estimates, the model is applied to estimate potential environmental concentrations of p-dichlorobenzene and trichloroethene. The claim of the model to yield values which apply to reasonable unfavorable environmental boundary conditions is satisfied for the air and for the biota (fish). Soil concentrations calculated by means of the model, assuming equilibrium with high air concentrations, are higher than the measured ones, while the calculated water concentrations are lower than the values often measured for river waters. This may be attributed to direct input of the substances into water, which is not being taken into account. Estimations of possible concentrations of volatile substances in the environment by means of most models have so far failed because of the necessity of taking into account many diffuse emission sources. The EMSA is suitable for estimating regional exposure concentrations for reasonable worst cases even in the case of such a use pattern. (Moore-IVI)
W85-02700

**RELATIVE SOURCE CONTRIBUTIONS OF DIET AND AIR TO INGESTED ASBESTOS EXPOSURE,**
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
J. N. Rowe.
Environmental Health Perspectives, Vol. 53, p 115-120, November, 1983. 5 Tab, 24 Ref.

Descriptors: *Asbestos, *Drinking water, *Epidemiology, Public health, Foods, Air pollution, Carcinogens.

The potential relative source contributions of diet, air and drinking water sources to ingested asbestos exposure are discussed. Information gaps in this area exist that preclude an accurate measure of the total ingested load of asbestos. Along with possible asbestos in food products and in the air, asbestos is also present in drinking water. The mean asbestos concentrations from a large number of drinking water sources in the United States have been reported to range from below detectable limits to over 1 billion fibers/liter. Most asbestos concentrations were below detectable limits or not statistically significant. Only 11% were greater than 1,000,000f/liter. Several different analyses of waterborne asbestos have been made and are tabulated. It might prove useful in the future studies to have geographic site-specific data on both ambient water and air concentrations of asbestos in order to make an accurate comparison of the relative contribution of each source to ingested asbestos exposure. (Baker-IVI)
W85-02711

**HOW ARE THE PHYSICAL AND CHEMICAL PROPERTIES OF CHRYSOTILE ASBESTOS ALTERED BY A 10-YEAR RESIDENCE IN WATER AND UP TO 5 DAYS IN SIMULATED STOMACH ACID,**
Arizona Univ., Tucson. Dept. of Metallurgical Engineering.
K. Seshan.
Environmental Health Perspectives, Vol. 53, p 143-148, November, 1983. 11 Fig, 2 Tab, 20 Ref. EPA grants CR80700 and BRSG S07 RR07002.

Descriptors: *Asbestos, *Chemical reactions, *Chrysotile, *Physical properties, Fate of pollutants, Acidity, Storage, Zeta potential, Magnesium, Refractive index, X-ray diffraction, Electron diffraction, Pollutant identification.

Various tests and techniques were used to study the effect of exposure to simulated gastric juices as well as the effect of long term storage in water on asbestos fibers. Changes were noted in the physical, chemical and surface properties of chrysotile asbestos as a result of exposure to water, strong acids, and simulated gastric juices. The charge on the surface (the zeta potential) was changed from positive to negative; the surface became silica-like; and the magnesium was lost from the asbestos fibers on exposure to water and acid. The smaller the fiber diameter, the faster the loss of the magnesium. Notable among the changes in physical properties is a change in the refractive index. Asbestos exposed to acids or water may not be detectable using the dispersion staining techniques that identify asbestos based on the refractive index. Other physical property changes include the destruction of the gross crystallinity of the fibers. The x-ray diffraction signal disappears when fibers are exposed to acid. The fibers may still be detected by electron diffraction. Upon acid exposure, the magnesium ions are leached out, leaving a magnesium-free silica network. A positive ion, possibly the proton or the hydronium ion, replaces the lost magnesium ion. (Baker-IVI)
W85-02713

**HYDROLYSIS OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE AT PARTS PER BILLION LEVELS IN AQUEOUS MEDIUMS,**
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
A. T. Lemley, and W.-Z. Zhong.
Journal of Agricultural and Food Chemistry, Vol. 32, No. 4, p 714-719, July/August, 1984. 3 Fig, 8 Tab, 22 Ref. EPA grant R809867.

Descriptors: *Pesticides, *Fate of pollutants, *Aldicarb, *Aldicarb sulfoxide, *Aldicarb sulfone, *Hydrolysis, Organic compounds, Toxicity, Chemical reactions.

As part of a larger study to systematically investigate detoxification methodology for carbamate pesticides in drinking water, degradation rates of aldicarb, aldicarb sulfoxide, and aldicarb sulfone in aqueous solution were measured. Pseudo-first-order rate constants for base hydrolysis were determined for 25 ppb solutions of each species at 15 C. Second-order rate constants were calculated, and the order for rate of hydrolysis was found to be the same as that reported for ppm solutions: aldicarb sulfone > aldicarb sulfoxide > aldicarb. The temperature effect for hydrolysis of aldicarb sulfone was determined, and Arrhenius behavior was observed. An activation energy of 15.6 kcal/mol was calculated. Base hydrolysis rates of aldicarb sulfone in chlorinated water and in actual well water were measured and found to be slower than those measured in distilled water. Data for rates of hydrolysis were extrapolated to hydroxide ion concentrations equivalent to environmental pH values, and good agreement with experimental data ob-

tained in buffered pH solutions is shown. (Baker-IVI)
W85-02720

**PHOTOCHEMISTRY AND VOLATILITY OF DREPAMON IN WATER,**
California Univ., Davis. Dept. of Environmental Toxicology.
W. M. Draper, and D. G. Crosby.
Journal of Agricultural and Food Chemistry, Vol. 32, No. 4, p 728-733, July-August, 1984. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Fate of pollutants, *Herbicides, *Photochemical reactions, *Chemical reactions, Degradation, Drepamon, Volatility.

The aquatic environmental chemistry of the herbicide Drepamon was investigated in laboratory studies of photochemical reactivity and volatilization. The major dissipative processes for Drepamon in a rice field under typical field use conditions will be volatilization and photodecomposition. Drepamon transport to the atmosphere is most important with predicted half-life values of less than 5 days. At the recommended rate of application, however, insolubility may retard volatilization. Thiobencarb is considerably less volatile than molinate or Drepamon and is expected to remain in the aqueous compartment. In midsummer sunlight Drepamon will undergo direct photodecomposition through an identifiable pathway leading to benzaldehyde. Photochemical oxidants and other naturally occurring substances may significantly accelerate photodecomposition rates, possibly resulting in the formation of hydroxylated products, sec-butylamine, and sulfur-carbamoyl cleavage products. (Baker-IVI)
W85-02721

**LEAVENWORTH, WASHINGTON CASE: ENVIRONMENTAL CONCERNS WITH A WATER TREATMENT PLANT FAILURE,**
Bio Chem Environmental Services, Inc., Seattle, WA.
W. L. Carberry, J. R. Deffenbach, G. Schlender, A. Jensen, and T. F. Wetzler.
Journal of Environmental Health, Vol. 47, No. 1, p 10-14, July-August, 1984. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Water treatment facilities, *Public health, *Leavenworth, *Washington, *Protozoa, Human diseases, Water pollution effects, Yersinia, Giardia, Epidemiology.

In April of 1980, 4 cases of suspected giardiasis were reported from the Leavenworth area of Washington State. A review of these 4 initial, and 2 subsequent, cases indicated that the Leavenworth community water supply carried the infection. Multiple etiologic agents appeared responsible for the outbreak, including Giardia lamblia and Yersinia enterocolitica. Monthly sampling of the water supply a year before the outbreak showed a presence of virulent Y. enterocolitica. A filtered water sample yielded G. lamblia after the outbreak had been spotted. Failure of the sand filtration system and the absence of adequate chlorination and pretreatment at the Leavenworth water treatment plant allowed these pathogens to enter the distribution system. In areas where the primary water source is an undeveloped protected watershed with abundant wildlife, water treatment plant operators must be particularly careful to protect the public's health from the sporadic organisms indigenous to the particular area. Operators must be aware of the presence of potential disease causing agents and take necessary measures to prevent the occurrence and distribution of these organisms in the finished product. (Baker-IVI)
W85-02723

**CONCENTRATION AND DEPOSITION OF ACIDITY, MAJOR IONS AND TRACE METALS IN THE SNOWPACK OF THE EASTERN CANADIAN SHIELD DURING THE WINTER OF 1980-1981,**
Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie, and R. J. Vet.
Atmospheric Environment, Vol. 18, No. 7, p 1459-1469, 1984. 4 Fig, 7 Tab, 19 Ref.

Descriptors: *Trace metals, *Snowpack, *Canadian Shield, *Water pollution sources, *Acid precipitation, Sulfates, Nitrates, Snow, Lead, Ions, Air pollution, Metals.

Snowpack chemistry surveys are useful tools in determining atmospheric pollutant deposition rates, provided care is taken to avoid the confounding influence of pollutant loss during thaws and due regard is given to sample representativeness. A chemical survey of the snowpack in Eastern Canada, conducted in late January 1981, yielded the concentration of total deposition of major ions and several trace metals. It was observed that the snowpack which had accumulated during December 1980 and January 1981 over eastern Canada was acidic and had on the average 60% more nitrate ion equivalents than sulfate ion equivalents. Thus nitrogen oxides were a potentially greater source of meltwater acidity than sulfur oxides were. Quantitatively detectable concentrations of the metals Pb, Ni, Cu, V, Cr, Fe, Mn, Al and Ba were found. Of these Pb, Ni, Cu, V and Cr were of anthropogenic origin. By studying the representativeness of a snowcore chemistry measurement in an area of diameter 100 km, limitations of the observations were defined for each substance of interest. All the trace metals except Mn and Ba were significantly enriched in the snowpack relative to crustal rock composition. (Baker-IVI)
W85-02730

**MEASUREMENTS OF S(IV) AND ORGANIC ANIONS IN MINNESOTA RAIN,**
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
S. F. Guiang III, S. V. Krupa, and G. C. Pratt.
Atmospheric Environment, Vol. 18, No. 2, p 1677-1682, 1984. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Acid rain, *Sample preservation, *Sulfur, *Minnesota, Pollutant identification, Rainfall, Organic compounds, Organic acids, Gas exchange, Hydrogen ion concentration.

In 167 fractions from 84 rain events collected at two sites in Minnesota during the summer of 1982, S(IV) accounted for 1.12% of the measured anions and thus usually contributed very little of the free acidity. A few events were observed, however, in which the S(IV) contribution was large. Organic acids were observed in nearly every fraction, with acetate being the most abundant. The samples were not preserved to prevent the loss of organic acids, which made an accurate assessment of the contribution of the organics to the acidity impossible and may have accounted for the low amounts of formate observed. The pH of samples in storage increased with time, a phenomenon which appeared to be related to gas exchange since the most dramatic changes in pH occurred when samples were first unsealed and exposed to outside air. Biological activity or dissolution of mineral material as possible causes for pH changes in storage cannot be ruled out. (Baker-IVI)
W85-02731

**CHEMISTRY OF BULK PRECIPITATION AT A SITE IN SOUTHEAST ENGLAND - I. SMALL-SCALE SPATIAL VARIATION, FREQUENCY DISTRIBUTIONS AND VARIATION WITH TIME,**
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 2K.
W85-02732

**CHEMISTRY OF BULK PRECIPITATION AT A SITE IN SOUTHEAST ENGLAND - II. RELATIONSHIPS BETWEEN IONS AND COMPARISON WITH OTHER SITES,**
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 2K.
W85-02733

**EFFECTS OF PH ON THE RELEASE TO SOLUTION OF ZINC, COPPER AND NICKEL FROM METAL-LOADED SEWAGE SLUDGES,**
Rothamsted Experiment Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
T. McM. Adams, and J. R. Sanders.
Environmental Pollution (Series B), Vol. 8, No. 2, p 85-99, 1984. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Acidity, *Metals, *Sludge, *Zinc, *Copper, *Nickel, Water pollution sources, Path of pollutants, Hydrogen ion concentration, Heavy metals.

The fertilizer value of sewage has been known for a long time, but the associated problems of phytotoxic elements have only been recognized more recently. The variation with pH of metal released from sludge was studied in sludges each containing significant amounts of only one contaminant metal. Metal released from four sludges was studied as the pH of sludge-water suspensions was varied by the addition of nitric acid or potassium hydroxide. As the pH decreased below a threshold value, the concentration of metal released from the sludge to the supernatant liquid increased. This threshold was about 5.8 for zinc loaded sludge, 6.3 for nickel loaded sludge, and 4.5 for copper loaded sludge. The metal content of the supernatant was small and relatively constant above these threshold values. In speciation experiments the proportion of soluble copper present and Cu(2+) in calcium chloride solution was related to pH, whereas the proportion of soluble zinc present as Zn(2+) was scarcely correlated with pH. (Baker-IVI)
W85-02742

**ENVIRONMENTAL AND CHEMICAL FACTORS INFLUENCING THE BIODEGRADATION OF PHTHALIC ACID ESTERS IN FRESHWATER SEDIMENTS,**
Columbia National Fisheries Research Lab., MO.
B. T. Johnson, and M. A. Heitkamp.
Environmental Pollution (Series B), Vol. 8, No. 2, p 101-118, 1984. 2 Fig, 5 Tab, 30 Ref.

Descriptors: *Phthalic acid esters, *Chemical reactions, *Fate of pollutants, *Biodegradation, Lake sediments, Temperature, Microorganisms, Dissolved oxygen, Nutrients.

Phthalic acid esters (PAEs) are common aquatic contaminants in the environment. Environmental and chemical factors which may determine the fate and persistence of PAEs in natural ecosystems were investigated in lake sediments: type of ester side-chain; oxygen tension; concentration of the test chemical; temperature; organic and inorganic nutrient enrichment; and pre-exposure of PAEs to indigenous microbiota. The primary biodegradation of PAEs, although influenced by several environmental factors, was chiefly determined by the complexity of the diester alkyl group. Under various experimental conditions the biodegradation of PAEs consistently had an inverse relation to length and branching of their alkyl groups. The findings stress the importance of molecular structure in predicting the environental persistence of chemicals with a common moiety. The complex alkyl phthalate DEHP in sediments biodegraded under anaerobic conditions and even though the process was slow both primary and ultimate degradation did occur. (Baker-IVI)
W85-02743

**RUNOFF WATER QUALITY FROM FRESH MINE SPOIL,**
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, J. C. Thomas, and K. W. Launius.
Environmental Pollution (Series B), Vol. 8, No. 2, p 119-131, 1984. 7 Fig, 1 Tab, 14 Ref. Bureau of Mines grant J0295016.

Descriptors: *Water quality, *Water pollution sources, *Mine wastes, *Runoff, Lignite, Iron, Manganese, Sediment load.

The pH of runoff from simulated spoil piles remained between 6 and 7 for 40 to 60 days and then

decreased slowly as the material weathered. The lowest runoff pH value measured was 5.0. Therefore, only slight acidification of the receiving waters is anticipated within the first 141 days. EC values of the runoff indicated no salt hazard to receiving waters. Some of the spoil materials, particularly in the Atascosa County and Grimes County locations may pose an initial salinity hazard to vegetation. Iron contents of the runoff from simulated spoil piles were low and only on one occasion exceeded 3.5 mg/liter. Manganese contents of runoff were also low. Therefore no excessive Fe or Mn additions to receiving waters are expected. The sediment content of the runoff water was very high, and all runoff form spoil piles will need to be managed to reduce sediment load prior to discharge. (Baker-IVI)
W85-02744

**TRANSFER OF LEAD BY FRESHWATER SNAILS IN ULLSWATER, CUMBRIA,**
Westfield Coll., London (England). Dept. of Botany.
M. Everard, and P. Denny.
Environmental Pollution (Series A), Vol. 35, No. 4, p 299-314, 1984. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Lead, *Snails, *Cumbria, *England, *Sediments, *Path of pollutants, Heavy metals, Water pollution effects, Food chain.

The cycling of lead by freshwater snails from primary producers and detritus, through the snails and snail-predators, and back into the sediment was investigated. The concentrations of lead in snails collected from Ullswater, Cumbrian, correlated with the degree of contamination at particular sites. When snails were fed on lead-enriched food in the laboratory, their digestive glands, feet and shells all accumulated the metal to some extent. It was not distributed equally among the tissures of Lymnaea peregra; the foot and digestive gland normally contained 2 to 4 and 3 to 10 times more lead than the shell, respectively. It appears that lead is laid down inexchangeably in the structural material of the shell while in soft tissues lead-containing granules are induced. These may be relocated and excreted and, when snails are transferred to lead-free conditions, their total lead content falls back to near-background levels. In Ullswater, contaminated snails, containing up to 5.6 mg Pb/g dry weight, are grazed by eels almost exclusively for some periods of the year but the majority of lead ingested by the fish passes straight through the gut. (Author's abstract)
W85-02747

**QUANTITIES OF SOME DANGEROUS SUBSTANCES DISCHARGED TO BRITISH COASTAL WATERS,**
Water Research Centre, Stevenage (England).
A. R. O'Donnell, and G. Mance.
Marine Pollution Bulletin, Vol. 15, No. 8, p 284-288, August, 1984. 1 Fig, 2 Tab, 2 Ref.

Descriptors: *England, *Wales, *Scotland, *Northern Ireland, *Coastal waters, *Tidewater, *Water pollution sources, *Pollutants, Cadmium, Mercury, Lindane, DDT, Aldrin, Dieldrin, Endrin, Polychlorinated biphenyls, Copper, Lead, Chromium, Nickel, Zinc, Arsenic, Trace metals, Chlorinated hydrocarbons, Pesticides, Path of pollutants.

The quantities of selected substances discharged into the tidal waters of the United Kingdom was estimated from 1980 data obtained from the Department of the Environment's Harmonized Monitoring and Surface Water archives. The substances surveyed for were cadmium, mercury, lindane, DDT, aldrin, dieldrin, endrin, PCBs, copper, lead, chromium, nickel, zinc and arsenic. Sub-totals of the estimated loads were determined for England, Wales, Scotland, and Northern Ireland and total flows were determined for river, sewage, and industrial inputs. Generally, the largest load component is derived from riverine inputs, with the loads from estuarine and coastal sources being of secondary and tertiary importance respectively. Direct industrial discharges into estuaries constitute the largest input of chromium and arsenic and the second largest input of mercury, copper, lead, and zinc. Within each of the home countries, the contribution of different sources to the load of each substance also varied. (Collier-IVI)
W85-02759

**BEHAVIOUR OF HEXACHLOROCYCLOHEXANE ISOMERS AND ZN, CU AND CD IN THE FRESHWATER-SEAWATER MIXING AREA,**
Texas A and M Univ., College Station. Dept. of Oceanography.
J. L. Sericano, H. V. Zubillaga, and A. E. Pucci.
Marine Pollution Bulletin, Vol. 15, No. 8, p 228-294, August, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Naposta Grande, *Blanca Bay, *Argentina, *Hexachlorocyclohexane, *Zinc, *Copper, *Cadmium, *Saline-freshwater interfaces, *Fate of pollutants, Suspended solids, Dissolved phase, Chemical precipitation, Dieldrin, DDT, Heptachlor, Lead, Coastal water.

During the freshwater-seawater mixing process, organochlorine and heavy metals may be redistributed between their dissolved and suspended forms. Because dissolved and suspended forms have different transport mechanisms through the mixing region out into the seawater, it is important to distinguish between the two forms to understand what effect pollutants derived from river systems may have on the levels in the marine environment. Concentrations of dissolved and suspended hexachlorocyclohexane isomers (alpha, gamma, and delta HCH), Zn, Cu and Cd were determined in the Naposta Grande stream, located in the Blanca Bay area, Argentina, for the purpose of studying the behavior of these compounds in the freshwater-seawater mixing zone. Dieldrin, o-p' DDT, p-p' DDT, heptachlor, and Pb were not present at detectable levels. The dissolved concentrations of hexachlorocyclohexane isomers and of heavy metals in both freshwater and in the mixing zone are much higher than those in suspension. Hexachlorocyclohexane isomers and Zn, Cu, and Cd seem to be removed from solution by suspended matter which is aferward precipitated during the freshwater-seawater mixing process. In relation to pollutants transported by freshwater streams, pollution in Blanca Bay is primarily a coastal problem since part of the load is deposited in the sediments when passing from the freshwater region through the mixing area to the coastal seawater. (Collier-IVI)
W85-02760

**CHLORINATED HYDROCARBONS IN FISH-EATING BIRDS WINTERING IN THE GDANSK BAY, 1981-82 AND 1982-83,**
Veterinary Hygiene Research Station, Gdansk (Poland).
J. Falandysz, and P. Szefer.
Marine Pollution Bulletin, Vol. 15, No. 8, p 298-301, August, 1984. 2 Tab, 18 Ref.

Descriptors: *Gdansk Bay, *Poland, *Chlorinated hydrocarbons, *Waterfowl, *Water birds, *Bioaccumulation, Birds, Hexachlorobenzene, Benzenehexachloride, DDT, Polychlorinated biphenyls, Auks, Mergansers, Divers, Grebes, Bays, Path of pollutants.

Seventy-four samples of adipose fat of 10 species of fish-eating birds commonly wintering in Gdansk Bay and one of little auk, a rare species in this area, have been analysed for residues of hexachlorobenzene (HCB), total-benzenehexachloride (BHC), total-DDT and polychlorinated biphenyls (PCBs). Auks (guillemot, black guillemot and razorbill), which probably stay a whole year in the Baltic area, contained in their fat twice the level of PCBs as mergansers, and 5-6 times as much as in divers and grebes-birds which stay in the sea mainly after the breeding season. Total-DDT levels were somewhat higher but comparable in auks and grebes, and lower in mergansers and divers. Total-BHC and HCB levels were 3-4 times and 5-10 times higher, respectively, in auks than in birds from other families studied. When comparing residue levels found in adipose fat of birds taken during the wintering seasons of 1981-82 and 1982-83 with those taken in 1975-76 or 1980-81, an initially rapid, but in recent years a rather slow decline in total-DDT level is detectable for grebes, mergansers and divers, and in the case of PCBs the residue levels fell slightly. In auks, the total-DDT residue level fell by half, but remains rather stable in recent years, while there are only minor fluctuations in the residue level of PCBs. (Author's abstract)
W85-02762

**HEAVY METALS IN RECENT SEDIMENTS FROM THE BAY OF CADIZ, SPAIN,**
Cadiz Univ. (Spain). Dept. de Quimica-Fisica.
A. Gomez Parra, R. Establier, and D. Escolar.
Marine Pollution Bulletin, Vol. 15, No. 8, p 310-311, 1984. 6 Fig, 2 Tab, 6 Ref.

Descriptors: *Bays, *Heavy metals, *Sediments, *Fate of pollutants, *Bay of Cadiz, *Spain, Water pollution sources, Shipping, Traffic, Lead, Manganese, Organic matter.

Stations in the bay to the west of the study area are characterized by compact sediments with very low levels of organic matter and heavy metals. An exception is noted in a high Mn content at a sampling staion near to an important effluent from Cadiz city. The area east of the bay is characterized by high levels of organic matter, phosphates and heavy metals. Values in the channels show an increase in the concentration of metals and phosphates and a decrease in the solid content of the wet samples. This is due to the greater stagnancy of the water which also produced greater uniformity in the physical characterisics of the bottoms and greater homogeneity in the chemical composition of the sediments of the 10 sampling stations. In each channel the highest organic matter, phosphate and metal content coincided with finer sediment granulometry. High values for lead were found in the vicinity of some sampling stations and are attributed to road traffic or the naval industry. (Baker-IVI)
W85-02764

**BROMINATED PHENOL PRODUCTION FROM THE CHLORINATION OF WASTEWATER CONTAINING BROMIDE IONS,**
Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 395-399, October, 1984. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Bromine, *Water pollution sources, *Chlorination, *Wastewater treatment, Disinfectants, Water treatment, Brominated phenols, Phenols, Organic compounds.

Non-chlorinated wastewater samples were obtained from a sewage treatment plant in Osaka, Japan. Calcium hypochlorite was used to chlorinate the samples, with potassium bromide as the source of bromide ions. The results indicate that brominated phenols are possibly formed through chlorination of wastewater. Also the production of brominated phenols along with chlorinated phenols had been reported earlier. The formation of brominated phenols in the chlorination of sea water used as coolant at power plants is also expected, because of the high level of bromide ions in sea water, about 65 ppm. Consequently, environmental pollution by brominated phenols formed in the chlorination of water is suspected. Brominated phenols present in the environment should be carefully controlled when using chlorine oxides as water disinfectants. (Baker-IVI)
W85-02776

**RELATIVE IMPORTANCE OF DIETARY AND ENVIRONMENTAL SOURCES OF LINDANE IN FISH,**
Liege Univ. (Belgium). Zoology Inst.
C. Marcelle, and J.-P. Thome.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 423-429, October, 1984. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Pesticides, *Fish, *Toxicity, Organic compounds, Water pollution effects, Path of pollutants, Lindane, Fish food, Food chain.

Under laboratory conditions the importance of both dietary and environmental paths of entry of pesticides into fish was evaluated. Gudgeons (Gobio gobio) were fed with contaminated and noncontaminated Chironomidae larvae. Fish and larvae kept in tanks containing 1.1 ppb lindane for an 18 day intoxication period, followed by a 30 day detoxification period in tap water. Fish were fed once every two days during the intoxication period and were not fed during the detoxication period. The lindane concentration in Chironomidae larvae at the beginning of the experiment was 50 ppb; this concentration reached 100 ppb after a week of exposure. The decimal lindane concentration in the brain increased exponentially with the time of exposure to lindane; on the other hand, lindane concentration in liver increased linearly with the time of exposure to the toxicant. For detoxication, a two way analysis of variance of the results obtained for liver did not show significant differences in lindane contents found in liver of fish fed with normal or contaminated food. Thus the detoxication rate in liver did not depend on the nature of food. A significant logarithmic correlation was found between pesticide content in liver and duration of detoxication. In brain, detoxication rate seemed to depend on the type of food given during the intoxication period. When fish were fed with contaminated food, the detoxication in brain was slower than in fish fed with non contaminated food. This chronic intoxication study has shown that the transfer of pesticide via the food chain was of lesser importance to the accumulation of pesticide than the direct uptake from water. (Baker-IVI)
W85-02779

**TRANSFORMATION AND FATE OF ORGANIC ESTERS IN LAYERED-FLOW SYSTEMS: THE ROLE OF TRACE METAL CATALYSIS,**
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Engineering Materials.
M. Plastourgou, and M. R. Hoffmann.
Environmental Science and Technology, Vol. 18, No. 10, p 756-764, October, 1984. 5 Fig, 5 Tab, 27 Ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Trace metals, *Stratified flow, Model studies, Mass transport model, Lakes, Estuaries.

A simple mass transport model with chemical and biochemical reactions was developed to predict the relative degree of degradation of organic esters in a layered-flow or density-stratified system. A numerical method was used to solve a system of differential equations involved when metal-catalyzed hydrolysis, biodegradation, and adsorption were assumed to be major pathways for ester transformation. The relative importance of each pathway for the time-dependent concentration profiles of an organic ester was examined by use of dimensionless parameters given a known initial concentration profile across the depth of the water column for a catalyst, for a microbial population, for particles, and for a hypothetical ester. The model as presented is applicable to transformations which are likely to occur in density-stratified lakes, in estuarine waters, and in surface organic microlayers. The model is useful for the inflow of wastewater or estuarine water at a specific depth in a density-stratified water system; for well-mined estuarine water that flows into a lake and forms a stable layer at its neutral bouyancy point which can be assumed to be vertically well mixed; for a layer in which the suspended particles or biomass concentrations are high in the water column; or atmospheric deposition of organic and inorganic components into a surface organic microlayer. (Baker-IVI)
W85-02805

**CHLORINE UTILIZATION DURING TRIHALOMETHANE FORMATION IN THE PRESENCE OF AMMONIA AND BROMIDE,**
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
G. L. Amy, P. A. Chadik, P. H. King, and W. J. Cooper.
Environmental Science and Technology, Vol. 18, No. 10, p 781-786, October, 1984. EPA contracts CR810277-01 and R809935-01.

Descriptors: *Chlorination, *Humic acids, *Bromide, *Trihalomethanes, *Ammonia, Water pollution sources, Chloroform, Disinfection, Water treatment, Chloramines.

The chlorination of humic substances in the presence of ammonia and bromide and the resultant formation of trihalomethanes (THM) are described. The presence of ammonia substantially reduced but did not eliminate THM production during the chlorination of waters containing humic substances. The presence of bromide ion in waters containing humic substances leads to increased THM formation, both in the presence and in the absence of ammonia. In waters containing ammonia, bromide, and humic substances, brominated haloforms can form upon chlorination. Brominated species comprise a larger portion of the total THMs at higher chlorine doses within the free chlorine region of the breakpoint curve than at lower doses in the subbreakpoint region. Although the THM formation reaction is slow and may not be complete even after 1 week of reaction time, the initial rate of formation is competitive with the relatively rapid reactions of bromide oxidation and chloramine formation. After free chlorine is converted to chloramines, THM production should theoretically cease. THMs will form in parallel with chloramine formation. This behavior has important implications for water utilities that use a raw water source containing low but significant levels of ammonia such as the Biscayne Aquifer, or are considering chloramine disinfection as a THM control strategy. (Baker-IVI)
W85-02806

**HYDROLYTIC AND METABOLIC PRODUCTS OF ACEPHATE IN WATER AND MOUSE LIVER,**
California Univ., Riverside. Div. of Toxicology and Physiology.
A. C. Chukwudebe, M. A. Hussain, and P. C. Oloffs.
Journal of Environmental Science and Health, Vol. B19, No. 6, p 501-522, August, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Fate of pollutants, *Acephate, *Insecticides, *Organophosphorus compounds, *Water analysis, Metabolism, Organic compounds, Water pollution sources, Toxicity, Hydrolysis.

Acephate is an organophosphorus insecticide used against infestations of the western spruce budworm in British Columbia forests. Aerial application of the chemical may result in contamination of lakes and streams and may have an impact on aquatic insects and fish. Hydrolytic and metabolic products of acephate in water and in mammals were assessed for their anticholinesterase properties. The pattern of hydrolysis of acephate in water is biphasic, with a fast and then a very slow phase. The major metabolite in water is O,S-dimethyl phosphorothiolate (DMPT) which increases almost proportionately to the decrease in acephate concentration. The next two metabolites in water are methamidophos and O-methylacetyl phosphoramidothiolate (OMPT), and are not produced to any major degree. In mouse liver metabolism of acephate produces methamidophos as an early metabolite, followed by DMPT and S-methylacetyl phosphoramidothiolate (SMPT). The amount of methamidophos formed in the water and mouse liver was too low to have any direct effect on the toxicity of acephate. Acephate toxicity to aquatic insects depends on its persistence in water, its uptake by the insects, its conversion to methamidophos, and the combined inhibitory effect of acephate and methamidophos on the cholinesterase enzyme. The toxicity of acephate to mammals depends on the direct anticholinesterase effect of the chemical and to a small extent on methamidophos. (Baker-IVI)
W85-02813

**UNDERSTANDING SIMPLIFIED LAKE ACIDIFICATION MODELS,**
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W.-S. Lung.
Journal of Environmental Engineering, Vol. 11, No. 5, p 997-1002, October, 1984. 2 Fig, 7 Ref.

Descriptors: *Lakes, *Acidification, *Model studies, *Reviews, Sulfates, Calcium, Magnesium, Decision making, Reservoirs, Hydrogen ion concentration, Mixing, Seasonal variation.

A number of analytical models has been developed to examine the degree of acidification in lakes and impoundments. These models are reviewed by evaluating their assumptions, demonstrating their merits and pointing out their limitations. Specific models reviewed include simplified lake acidification models using the excess sulfate method and the pre-acidification alkalinity methods, pH versus calcium model, and the calcium and magnesium versus sulfate model. All these models are no more than statements of ionic balance in which many ions are negligible, cancel one another out, or do not contribute to acid-base reactions. All these empirical plots are based on chemical equilibrium assuming steady-state conditions. In reality, a lake rarely reaches a steady-state, but has seasonal cycles for various phenomena. Therefore, these simplified models cannot be used to examine the seasonal variation of acidity in lakes. The simplified models treat a lake as a completely mixed water body. This assumption is difficult to meet as many lakes are stratified during summer months and inversely stratified during winter months. The models described are very easy to use tools to identify lake acidification and to estimate the degree of acidification. However, such graphs provide no analysis capability beyond the finding that many surface waters can be positioned on the same graph. Without additional information, their predictive capability is highly limited because inferring acidification or the reverse of acidification are not accounted for. If significant decisions are to be made as to acidification control, more quantitative analysis techniques than these simple models are needed. (Baker-IVI)
W85-02822

**NUMERICAL SOLUTION OF THE DISPERSION EQUATION USING A VARIABLE DISPERSION COEFFICIENT; METHOD AND APPLICATIONS,**
Hong Kong Univ. Dept. of Civil Engineering.
A. W. Jayawardena, and P. H. Lui.
Hydrological Sciences Journal, Vol. 29, No. 3, p 293-309, 1984. 5 Fig, 9 Tab, 12 Ref.

Descriptors: *Streamflow, *Dispersion, *Fate of pollutants, Water pollution sources, Model studies, Mathematical models.

The study forms part of a wider research project on dispersion prediction in open channel flows which include laboratory, field and numerical investigations. A numerical model is presented which uses finite elements in space and finite differences in time for the solution of the convective-dispersion equation. The dispersion coefficient is considered as a function of time during the initial period. It is represented by a modified Fickian type model which has been calibrated by the authors using laboratory data. The numerical model has been used to predict concentration profiles of tracer studies carried out in the laboratory as well as in the field. (Baker-IVI)
W85-02828

**MAJOR ION AND CARBONATE SYSTEM CHEMISTRY OF A NAVIGABLE FRESHWATER CANAL,**
Liverpool Univ. (England). Dept. of Inorganic, Physical and Industrial Chemistry.
J. R. Howard, G. Skirrow, and W. A. House.
Freshwater Biology, Vol. 14, No. 5, p 515-532, October, 1984. 7 Fig, 10 Tab, 14 Ref.

Descriptors: *Water quality, *Carbonates, *Water analysis, *Leeds-Liverpool Canal, *England, Diur-

nal distribution, Canals, Carbon dioxide, Calcite, Supersaturation.

Water quality was examined in a 50 km length of the Leeds-Liverpool Canal from Wigan to Litherland using 17 sampling stations over a 15 mo period. Three principal contributory water types have been recognized, and the observations have allowed estimates to be made of their relative contributions ot the total water flux in the lower reaches of the system. Linear flow rates of about 0.6 km/day near Litherland are consistent with previous reports. Estimates of the partial pressure of carbon dioxide in the water, the degree of saturation of the water with respect to calcite and the major ion speciation in the water were obtained using the combined field and laboratory measurements. The program WATEQ was used for the estimates as it takes into account ion pairing. Diurnal and annual cycles with respect to pH, partial pressure of CO2 in the water, and degree of saturation of the water with respect to calcite occur, these being most marked in the lower parts of the study length when, for a large proportion of the spring and summer, partial pressure of CO2 was below the atmospheric level and noticeable supersaturation with respect to calcite occurred. In contrast, two of the contributory water types, the River Douglas input and the Creek, showed low pH and low degrees of saturation of the water with respect to calcite and high partial pressure of carbon dioxide values throughout the year. (Baker-IVI)
W85-02841

**CONCENTRATIONS AND ANNUAL LOADING OF DISSOLVED ORGANIC MATTER IN A SMALL MOORLAND STREAM,**
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Freshwater Biology, Vol. 14, No. 5, p 533-537, October, 1984. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Source of pollutants, *Dissolved solids, *Water analysis, *Peat, *Moorlands, Seasonal variation, Temperature effects, Erosion, Sediment load, Streams, Wetlands, Scotland.

Short-term variations in the concentrations and loadings of dissolved organic matter (DOM) in a moorland stream near Stirling, Scotland, sampled over a period of 1 yr are reported. The DOM was measured at 8 hr intervals in a stream draining 51 ha of moorland with peaty soils. DOM concentrations increased with increasing stream discharge from low flow values of 0-3 mg/l to a maximum value of 30 mg/l. There were also seasonal differences of up to 13 mg/l between August and February, and differences of about 2.5 mg/l between rising and falling stage samples. Seasonal variation was closely related to mean temperature. Total loss over the year was 168 kg/ha DOM larger than previous estimates for upland sites. Seasonal and stage differences combined with discharge control of DOM concentration make the estimation of annual DOM loss based on limited sample numbers or time-periods subject to potentially large errors. (Baker-IVI)
W85-02842

**SALINITY DEPENDENT ACCUMULATION OF ZN, CO AND MN IN SCYTOSIPHON LOMENTARIA (LYNGB.) LINK AND ENTEROMORPHA INTESTINALIS (L.) FROM THE ADRIATIC SEA,**
Slovenska Akademija Znanosti in Umetnosti, Ljubljana (Yugoslavia). Biological Inst.
I. M. Munda.
Botanica Marina, Vol. 27, No. 8, p 371-376, August, 1984. 3 Fig, 1 Tab, 44 Ref.

Descriptors: *Algae, *Heavy metals, *Accumulation, *Salinity, *Adriatic Sea, Zinc, Manganese, Cobalt, Fate of pollutants.

The uptake of Zn, Mn and Co was studied in two seasonal species from the North Adriatic Sea at three different salinities. Results indicate a dilution-enhanced metal accumulation in Scytosiphon lomentaria and Enteromorpha intestinalis for Zn, Mn, and Co. Under experimental conditions Zn exhibited the highest accumulation rate and Co the lowest. There are inconspicuous differences between the brown and green alga used in the present experiment. On the basis of these data it is not yet possible to advance an ecologically valid explanation for the observed phenomena. It is possible that cations added to the experimental media were accumulated on the surface, bound to polysaccharides which act as ion-exchange media, that is, alginic acid in brown algae and diverse sulfated polysaccharides in green algae. (Baker-IVI)
W85-02844

**MERCURY IN SOME HIGHER AQUATIC PLANTS AND PLANKTON IN THE ESTUARY OF THE RIVER KOKEMAENJOKI, SOUTHERN FINLAND,**
Helsinki Univ. (Finland). Dept. of Botany.
V.-R. Cajander, and R. Ihantola.
Annales Botanici Fennici, Vol. 21, No. 2, p 151-156, 1984. 2 Fig, 3 Tab, 31 Ref.

Descriptors: *Estuaries, *Mercury, *Fate of pollutants, *Finland, *River Kokemaenjoki, Aquatic plants, Sediments, Bioindicators, Monitoring, Dredging.

Eight species of higher aquatic plants, and seston and zooplankton were collected from 16 sampling sites in the eutrophic estuary of the River Kokemaenjoki and analyzed for mercury. The Kokemaenjoki has a length of 110 km and a mean discharge of 206 cu m/s. The quality of water is poor as it receives agricultural runoff, and waste waters from the wood processing, metal and chemical industries and domestic effluents from urban centers. The mean Hg concentration in the aquatic plants was 0.43 ppm of dry weight, in the seston 0.71 ppm and in the zooplankton 1.19 ppm. Among the aquatic plants, the highest Hg values were recorded in small bottom-rooted submerged Eleocharis acicularis (0.77 ppm) and Elatine spp. (0.80). The lowest Hg concentrations were found in the floating leaves of Nuphar lutae (0.04 ppm). The Hg concentrations of aquatic plants in the estuary were 5-20 times as high as those reported from unpolluted watercourses in Finland. The Hg contents of the seston and zooplankton were 5-20 times as high as the natural background levels. Submerged aquatic plants, seston and zooplankton appeared to be valuable indicators of mercury contamination in the delta area. The dredging operations planned for this area could harm the biota by releasing more Hg from the sediments to the overlying water and thus increasing the amounts circulating in the food webs. (Baker-IVI)
W85-02845

**ELECTRICAL METHODS OF DETECTING CONTAMINATED GROUNDWATER AT THE STRINGFELLOW WASTE DISPOSAL SITE, RIVERSIDE COUNTY, CALIFORNIA,**
California Univ., Riverside. Dept. of Earth Sciences.
D. J. Stierman.
Environmental Geology and Water Sciences, Vol. 6, No. 1, p 11-20, 1984. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Riverside, *California, *Stringfellow Waste Disposal Site, *Groundwater pollution, *Electrical studies, *Hazardous waste sites, Testing procedures, Geophysics, Electric potential, Mise-a-la-masse, Spontaneous potential, Electrical sounding, Dipole-dipole resistivity profiles, Path of pollutants.

At the Stringfellow Class I waste-disposal site near Riverside, California, the influence of variations in groundwater chemistry and saturation on electrical measurements made from the surface was tested. Spontaneous potential, D.C. electrical sounding, dipole-dipole resistivity profiles, and mise-a-la-masse measurements were employed to investigate the sub-surface migration of the acidic fluids deposited in this site between 1956 and 1972. Mise-a-la-masse exploration conducted at the downstream edge of the site detected a major anomaly which, on excavation, proved to be the signature of a previously unsuspected leak from the surface disposal ponds on the site. Downstream from the site, a dipole-dipole profile and electrical soundings correlate well with electrical conductivity of groundwater obtained from monitoring wells. This study demonstrates that geophysical methods may be used to search for and map leaks from toxic chemical waste dumps. (Author's abstract)
W85-02858

**PROTECTION OF GROUNDWATER FROM OIL POLLUTION IN THE VICINITY OF AIRPORTS,**
For primary bibliographic entry see Field 5G.
W85-02859

**HYDROCARBONS IN THE SURFICIAL SEDIMENTS OF LAKES ST. CLAIRE, ERIE, AND ONTARIO,**
Canada Centre for Inland Waters, Burlington (Ontario).
E. Nagy, P. Mudroch, A. Mudroch, and R. L. Thomas.
Environmental Geology and Water Sciences, Vol. 6, No. 1, p 31-37, 1984. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Lake Erie, *Lake St. Claire, *Lake Ontario, *Hydrocarbons, *Lake sediments, Lakes, Fate of pollutants, Path of pollutants, Sediments, Detroit River, Great Lakes.

Although the long-term effects and the fate of petroleum hydrocarbons in marine and freshwater environments are not fully understood, it is generally recognized that much of the oil released by accidental spills or by various land sources ends up in the sediment where it may remain for at least several years. The present study was undertaken to collect some initial data on the hydrocarbon concentrations in surficial sediments of lakes St. Claire, Erie, and Ontario. The distribution of hydrocarbons in these lakes followed the general patterns found for a number of contaminants, in that the distribution tended to coincide with the outlines of the sedimentary basins. The highest concentrations were found in the Western Basin of Lake Erie and in the inshore zone around the west end of the lake, suggesting major inputs from the Detroit River. Apart from some spots of high concentration around known dumping grounds, the concentrations gradually diminish toward the east. The distribution pattern in Lake Ontario may be more readily ascribed to water circulation patterns than to any specific source around the lake. The hydrocarbon levels were found to be significantly lower than those in Lake Erie. In Lake St. Clair only trace quantities of hydrocarbons were found, suggesting either low inputs or low sedimentation/accumulation rates due to its shallowness. Although the present survey was limited to the top 3 cm of the sediments, the resulting distribution patterns indicate the western end of the Lake Erie as the area with the heaviest hydrocarbon loadings. The results may also facilitate the selection of specific areas where core sampling coupled with more complete analysis of the extracts could yield significant information on the long-term accumulation of anthropogenic hydrocarbons, and on their persistence and transformations in Great Lakes sediments. (Author's abstract)
W85-02860

**ROLE OF INLAND WATER SEDIMENTS AS SINKS FOR ANTHROPOGENIC SULFUR,**
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu.
Science of the Total Environment, Vol. 38, p 7-13, 1984. 1 Fig, 1 Tab, 34 Ref.

Descriptors: *Sulfur, *Reservoirs, *Sediments, *Sinks, *Lake sediments, Sedimentation, Fate of pollutants, Iron, Great Lakes.

The possibility that the accumulation of sulfur in lake and reservoir sediments is sizeable and can account for some of the missing sulfur in the global sulfur budgets is explored. Typically, lake sediments are deficient in S and any sulfate ions transferred into this milieu are quickly reduced to the sulfide below the oxidized microzone. The pollu-

tion contribution to the SO4 concentrations in the waters of the Great lakes can be estimated using the change in the sulfur content of the recent sediments. From the rates of sediment accumulation and the S concentrations, the rates of S accumulation in recent and precolonial sediments of the Great Lakes have been derived. S accumulation rates in recent sediments of the Great Lakes are typical of values reported in other lakes. The ratio of organic carbon to sulfur provides a second estimate of the global S flux into sediments. The global flux of S to the reservoir sediment is estimated to be 8 Tg/y. This accounts for some, if not a large portion, of the missing sulfur in the global budget calculations, which has variously been estimated to be 28-280 Tg/y. Since the construction of new reservoirs continues, the reservoir sediments will likely increase in importance as the repository for S from the anthropogenic sources. (Baker-IVI)
W85-02864

**FLUORITE PRECIPITATION IN A CALCAREOUS SOIL IRRIGATED WITH HIGH FLUORIDE WATER,**
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2G.
W85-02873

**METALS IN FISH AND SEDIMENTS FROM THE RIVER KOLBACKSAN WATER SYSTEM, SWEDEN,**
Umea Univ. (Sweden). Dept. of Physical Geography and Geoecology.
L. Hakanson.
Archiv fur Hydrobiologie, Vol. 101, No. 3, p 373-400, September, 1984. 10 Fig, 20 Tab, 35 Ref.

Descriptors: *Kolbacksan River, *Sweden, *Lakes, *Trace metals, *Fish, *Sediments, Mercury, Cadmium, Lead, Copper, Chrome, Zinc Pike, Perch, Roach, Hydrogen ion concentration, Alkalinity, Bioindicators.

Sediment samples and muscle and liver from pike, perch and roach from seven Swedish lakes were analyzed for Hg, Cd, Pb, Cu, Cr and Zn. All comparisons are based on contamination factors, i.e., quotients between empirically determined mean values and natural background levels. As there are no data available on metals in fish from uncontaminated environments today, preindustrial levels of the metals in fish have been derived indirectly by using the 10th percentile values from the cumulative distribution curves for the given metals in the lakes investigated. Natural background levels for the metals in the sediments have been determined from sediment cores. The variability in metal concentrations in fish was found to depend primarily on the fish contamination factor (BK) and not on fish age, weight, species, organ, metal or lake. Stationary pike does not display less variability in metal concentrations than its prey. The sediments reflect the integrated dose of metals to the lake. The concentration in fish may be regarded as a response to the given dose. There are no clear-cut relationships between dose and response and the many environmental factors (e.g., pH, alkalinity, water retention time, level of bioproduction and type of 'carrrier particles') that govern the spread and the uptake of metals in fish. A pollution index (PI) illustrating the slope of the cumulative distribution curves has been used to quantify the range of contamination in fish and sediments. The PI-values reveal that pike liver and roach muscle give the best differentiating effect and pike muscle the least resolution, on average, for the investigated metals. For certain metals, like Cu and Zn, there is even a negative correlation between the dose factor, i.e., the sediment contamination factor, SC, and the response factor, e.g., the pike liver contamination factor. The correlation between the fish contamination factors is generally markedly positive. The strongest relationship with the sediment contamination are obtained for roach muscle (r = 0.57) and pike liver (r = 0.52). (Author's abstract)
W85-02896

**SEDIMENTATION OF POLYCHLORINATED BIPHENYLS (PCBS) IN LIMNIC AND MARINE ENVIRONMENTS,**
Lund Univ. (Sweden). Limnological Inst.
P. Larsson.
Water Research, Vol. 18, No. 11, p 1389-1394, 1984. 2 Fig, 2 Tab, 27 Ref.

Descriptors: *Polychlorinated biphenyls, *Sedimentation, *Sweden, *Lakes, *Bsys, Chlorinated hydrocarbons, Air pollution, Water pollution sources, Path of pollutants.

The sedimentation rates of PCBs in two southern Swedish lakes and a coastal bay in the southern Baltic were determined using sediment traps. The rates were similar at the three locations and ranged from 1.2 to 10.9 micro g PCBs/sq m/month during summer. The source for PCBs in sedimenting material is probably the atmosphere. PCB concentrations in sedimenting material were higher than those in surface sediment. This may be due to recirculation of sediment-bound PCBs. The reproducibility of collecting by sediment traps was examined by deploying duplicate traps simultaneously. There were no significant differences in PCB concentration of sedimenting material between traps in duplicate. Concentrations of PCBs in the different collecting vessel was similar within one trap. (Author's abstract)
W85-02911

**FATE OF CHLORINE AND CHLORAMINES IN COOLING TOWERS; HENRY'S LAW CONSTANTS FOR FLASHOFF,**
Exxon Research and Engineering Co., Annandale, NJ. Corporate Research Labs.
G. Holzwarth, R. G. Balmer, and L. Soni.
Water Research, Vol. 18, No. 11, p 1421-1427, 1984. 7 Fig, 1 Tab, 17 Ref.

Descriptors: *Chlorine, *Chloramines, *Cooling towers, *Henry's law, *Flashoff, Hypochlorous acid, Volatility, Ammonia.

Chlorine and chloramines are volatile compounds which are stripped ('flashed off') from recirculating cooling water systems by the large volumes of air which flow through the water cooling tower. The fraction of a volatile gas, such as hypochlorous acid (HOCl), which is removed by stripping is determined by Henry's constant H for that gas: H = (X sub G)/(X sub L), where X sub G is the mole fraction of the gas in the air and X sub L is the mole fraction of the gas in the water. H was measured for HOCl, OCl(-), NH3, NH2Cl, NHCl2 and NCl3 at 20 and 40 C. H = 0.076 for HOCl, compared to 0.71 for NH3, at 20 C. At 40 C, H was about 2.5-fold larger for HOCl. This means that 10-15% of the HOCl is stripped from cooling water on each passage through a typical cooling tower. The measured flashoff of free available chlorine (HOCl + OCl(-)) was markedly pH-sensitive with a pK of 7.5, exactly as expected if HOCl is volatile but OCl(-) is not. The data permit a quantitative understanding of the fate of chlorine in cooling systems. The values of H at 40 C for NH2Cl, NHCl2 and NCl3 were 1.28, 3.76 and 1067. This means that all the chloramines are quickly stripped in cooling tower. (Author's abstract)
W85-02915

**STUDY OF LANDSCAPE-AGROGEOCHEMICAL BALANCE OF NUTRIENTS IN AGRICULTURAL REGIONS: PART III. NITROGEN,**
Institut Fotosinteza, Pushchino (USSR).
V. N. Kudeyarov, and V. N. Bashkin.
Water, Air, and Soil Pollution, Vol. 23, No. 2, p 141-153, August, 1984. 9 Tab, 38 Ref.

Descriptors: *Russia, *Nitrogen, *Oka River, *Gorodnyanka River, *Skigna River, *Itska River, *Sokhna River, *Nutrient balance, *Groundwater pollution, Crop yield, Fertilization, Source of pollutants.

The small river basins of the Oka River (Russia) tributaries - the Gorodnyanka, Skigna, Itska, and Sokhna basins - are regions of different agricultural land use, soils erosion processes and level of fertilization. The landscape-agrogeochemical balance of nitrogen was estimated for each of the regions. The input values were shown to be considerably higher than output values during the 1969-1979 period. This was due to an increase in mineral fertilizer application with no commensurate rise in the export of agricultural production from the regions. The insignificant increase in the crop yield with the increasing amounts of N fertilizers applied may serve as a main reason of the observed accmulation. A significant positive correlation between the content of nitrates in the groundwater and the rates of N fertilizers was shown. Using the modulus of flow of groundwater of the upper water levels in the given basins, it was estimated that from 20 to 50% of accumulated N may leach into the groundwater. (Collier-IVI)
W85-02923

**COMPUTED AND MEASURED LEACHING OF THE INSECTICIDE METHOMYL FROM GREENHOUSE SOILS INTO WATER COURSES,**
Institute for Pesticide Research, Wageningin (Netherlands).
M. Leistra, A. Dekker, and A. M. M. van der Burg.
Water, Air, and Soil Pollution, Vol. 23, No. 2, p 155-167, August, 1984. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Methomyl, *Leaching, *Insecticides, *Soils, *Greenhouses, Water pollution sources, Fate of pollutants, Model studies.

The adsorption of methomyl onto three greenhouse soils was measured and was found to be weak to moderate. The transformation rates in three greenhouse soils were reasonably high with half-lives ranging from about 3 to 14 days. These data were introduced into two computational models of pesticide behavior in simplified greenhouse systems. The computed leaching of methomyl ranged from nil to very small (0.03% of the dose), depending on the transformation rate and the amount of irrigation water. The concentrations measured by HPLC in drainage water from three greenhouses were somewhat higher than computed, although they remained below 1 micro g/L. Various concentrations measured in water courses in an area with many greenhouses were distinctly higher than those measured in drainage water, which may be the result of discharge of surpluses of spray liquid into the water courses. (Author's abstract)
W85-02924

**INTERACTION OF CLAYS WITH DILUTE FLUORIDE SOLUTIONS,**
Newcastle Univ. (Australia). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W85-02928

**MECHANISMS AND PATHWAYS OF ANILINE ELIMINATION FROM AQUATIC ENVIRONMENTS,**
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
C. D. Lyons, S. Katz, and R. Bartha.
Applied and Environmental Microbiology, Vol. 48, No. 3, p 491-496, September, 1984. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Aniline, *Biodegradation, *Aquatic environment, Fate of pollutants, Ponds, Arylamines, Gas chromatography, Mass spectrometry, Humic acids, Catechol.

The fate of aniline, a representative of arylamine pollutants derived from the manufacture of dyes, coal liquefaction, and pesticide degradation, was comprehensively evaluated by use of unpolluted and polluted pond water as model environments. Evaporation plus autoxidation proved to minor elimination mechanisms, removing ca. 1% of the added aniline per day. Instantaneous binding to humic components of a 0.1% sewage sludge inoculum removed 4%. Biodegradation of aniline in pond water was accelerated by the sewage sludge inoculum. A substantial portion of the degraded aniline carbon was mineralized to CO2 within a 1-week period, and microbial biomass was formed as a result of aniline utilization. Biodegradation was

clearly the most significant removal mechanism of polluting aniline from pond water. A gas chromatographic-mass spectrometric analysis of biodegradation intermediates revealed that the major pathway of aniline biodegradation in pond water involved oxidative deamination to catechol, which was further metabolized through cis, cis-muconic, beta-ketoadipic, levulinic, and succinic acid intermediates to CO2. Minor biodegradation pathways involved reversible acylation to acetanilide and formanilide, whereas N-oxidation resulted in small amounts of oligomeric condensation products. (Author's abstract)
W85-02932

**HUMAN PATHOGENIC VIRUSES AT SEWAGE SLUDGE DISPOSAL SITES IN THE MIDDLE ATLANTIC REGION,**
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
S. M. Goyal, W. N. Adams, M. L. O'Malley, and D. W. Lear.
Applied and Environmental Microbiology, Vol. 48, No. 4, p 758-763, October, 1984. 3 Fig, 4 Tab, 31 Ref. NOAA grant NA80AA-D00049.

Descriptors: *Viruses, *Ocean dumping, *Atlantic Ocean, *Sludge disposal, Crabs, Sediments, Indicator bacteria, Pathogens, Fate of pollutants.

Human enteric viruses were detected in samples of water, crabs, and bottom sediments obtained from two sewage sludge disposal sites in the Atlantic Ocean. Viruses were isolated from sediments 17 months after the cessation of sludge dumping. These findings indicate that, under natural conditions, viruses can survive for a long period of time in the marine environment and that they may present potential public health problems to humans using these resources for food and recreation. The isolation of viruses in the absence of fecal indicator bacteria reinforces previous observations on the inadequacy of these bacteria for predicting the virological quality of water and shellfish. (Author's abstract)
W85-02939

**ISOLATION OF LEGIONELLA SPECIES FROM DRINKING WATER,**
Michigan Dept. of Public Health, Lansing. Bureau of Lab. and Epidemiological Services.
S. C. Hsu, R. Martin, and B. B. Wentworth.
Applied and Environmental Microbiology, Vol. 48, No. 4, p 830-832, October, 1984. 2 Tab, 12 Ref.

Descriptors: *Legionella, *Bacteria, *Drinking water, Coliforms, Chlorination, Disinfection, Water treatment, Sodium hypochlorite, Escherichia coli.

Three different species of Legionella were recovered from samples of water taken from chlorinated public water supplies where no coliform bacteria were simultaneously detected. Five of 856 samples yieled Legionella isolates. Three isolates were identified as Legionella pneumophila serogroup 1, the fourth was identified as Legionella dumoffi, and the fifth was identified as Legionella jordanis. Studies to determine the survival of L. pneumophila Flint 1 serogroup 1 in tap water at various temperatures and in tap water with added sodium hypochlorite were done. These organisms were found to survive for 299 days in tap water at 24 and 5 C but not at 35 C. A concentration of at least 0.2 mg of residual chlorine per ml was required to eliminate at least 90% of L. pneumophila and Escherichia coli inocula in 2 h. (Author's abstract)
W85-02941

**BIODEGRADATION OF 4-NITROPHENOL IN STANDARDIZED AQUATIC DEGRADATION TESTS,**
Vandkvalitetsinstitutet, Hoersholm (Denmark).
N. Nyholm, P. Lindgaard-Jorgensen, and N. Hansen.
Ecotoxicology and Environmental Safety, Vol. 8, No. 5, p 451-470, October, 1984. 7 Fig, 4 Tab, 36 Ref.

Descriptors: *Nitrophenols, *Biodegradation, *Chemical analysis, Toxicity, Bacteria, Degradation, Microbial degradation, Fate of pollutants.

During the years 1978-1981 both the European Economic Community (the EEC) and the Organization for Economic Cooperation and Development (the OECD) organized various interlaboratory comparison programs on standarized screening methods to study the biodegradability of chemicals in water. While the ring test results were generally rather heterogenous, one of the compounds studied, 4-nitrophenol, turned out to be particularly problematic as the compound was found either easily biodegradable or not biodegradable by various laboratories in various tests. This paper describes some more detailed studies on 4-nitrophenol degradation in two different tests, the Modified OECD Screening Test (MOST test) and the Zahn-Wellens test, respectively. The test variables investigated include inoculum characteristics and pretreatment, test duration, and 4-nitrophenol concentration. The results are discussed in relation to toxicity and degradation pathways of 4-nitrophenol. In order to improve the comparability of results from standardized aquatic biodegradation tests, test strategies should allow the option of performing a test with a preadapted inoculum in the event of negative test results with freshly collected inocula. Increasing the inoculated concentration of microorganisms in some tests may also contribute to the attainment of more consistent test results. (Author's abstract)
W85-02944

**FATE AND BIOLOGICAL EFFECTS OF METHYL PARATHION IN OUTDOOR PONDS AND LABORATORY AQUARIA; I. FATE,**
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
N. O. Crossland, and D. Bennett.
Ecotoxicology and Environmental Safety, Vol. 8, No. 5, p 471-481, October, 1984. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Parathion, *Fate of pollutants, *Water pollution effects, Tissue analysis, Sediments, Aquatic plants, Biodegradation.

Three outdoor ponds were treated with methyl parathion (MEP) applied beneath the water surface at a concentration of 100 micro g/liter. Laboratory aquaria containing either tap water, pond water, tap water plus plants, tap water plus sediment, or tap water plus sediment and plants were similarly treated. Samples of water, sediment, and fish were analyzed for residues of MEP. The rate of loss from water and concentrations found in sediment were compared with predictions based on a calculated rate of biodegradation and a sediment:water partition coefficient. The rate of loss of MEP from pond water isolated in an aquarium was similar to the predicted rate. However, the rate of loss from outdoor ponds, or from aquaria containing plants and sediment, was greater than predicted. MEP was not detected in sediment even though predicted concentrations far exceeded the limit of detection. These results are discussed and it is suggested that the rate of biodegradation in shallow bodies of water may be determined predominantly by bacteria attached to sediments and plants, rather than by planktonic bacteria. Bioaccumulation in fish was predicted from empirical equations based on the octanol:water partition coefficient. Observed values were in good agreement with predictions. (Author's abstract)
W85-02945

**TRACE METAL CONTENT OF LIVE TISSUES IN HALIMIONE PORTULACOIDES FROM COASTAL AREAS OF THE SADO ESTUARY, PORTUGAL,**
Universidade Nova de Lisboa (Portugal). Dept. of Chemistry and Biotechnics.
F. H. S. Reboredo.
International Journal of Environmental Studies, Vol. 23, No. 1, p 49-53, July, 1984. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Trace metals, *Bioindicators, *Halophytes, *Water pollution effects, *Sado Estuary, *Portugal, Aluminum, Zinc, Iron, Copper, Vegetation, Estuaries.

Trace metal concentration (Al, Cu, Fe, and Zn) in Halimione portulacoides from the coastal areas of the River Sado estuary were investigated. This area receives the untreated domestic sewage from a populous city - Setubal, and an important input of residual elements due to the high agricultural and industrial activity around and upstream from Setubal. The results clearly demonstrate that the live tissues of H. portulacoides from different sampling points present different degrees of metal accumulation. The highest levels of Al, Cu and Fe were always found in roots, while the lowest levels were always observed in stems. Copper and iron levels were highly correlated in all tissues while for Al and Zn high correlations were noted between the leaf and the stem. (Baker-IVI)
W85-02959

**CHLORIDE BUDGET FOR THE MISSISSIPPI RIVER HEADWATERS TO MOUTH,**
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel, and D. Livermore.
Water Resources Bulletin, Vol. 20, No. 2, p 503-509, August, 1984. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Mississippi River, *Chlorides, *Mass budget, *Water pollution sources, Ohio River, Rivers, Flow discharge, Precipitation, Road salting, Snowpack, Leaching, Dam effects, Reservoirs.

The chemical mass balance approach for the chemically conservative solute, chloride, is especially useful to differentiate between natural and anthropogenic source of solutes to river waters. Monthly data from 1974-1979 on river discharge and chloride concentrations were obtained at 16 sites along the Mississippi River and major tributaries for the data base of NASQAN and from annual data reports of the USGS. Chloride deposition from precipitation in the Mississippi river watershed generally reflects the proximity of a given location to the Gulf Coast, where precipitation is greater and contains higher concentrations of sea salt. Mass budgets for chloride were estimated for the Mississippi River from headwaters to near the mouth to determine the magnitudes of natural and anthropogenic sources. Annual chloride input from precipitation ranged from about 200 kg sq mi/yr at Royalton, Minnesota, to about 350 kg sq mi/yr at Vicksburg, Mississippi. Mass export ranged from about 900 kg sq mi/yr at Royalton to about 8000 kg sq mi/yr at Vicksburg. As much as 80% of the residual, the difference between input and export, probably is contributed by anthropogenic sources. Semi-logarithmic scatterplots of monthly total discharge against chloride concentration show that, during early spring, chloride elevations in the Mississippi River and the Ohio River are elevated, possibly because of flushing of road salt and leaching of chloride from the accumulated snowpack. Scatterplots of chloride versus discharge for sites on the Mississippi River show great scatter, without the definition of discrete straightline segments. This suggests numerous sources of anthropogenic chloride unrelated to season and the effects of hydrologic control of river discharge through reservoirs and dams. (Moore-IVI)
W85-02976

**MULTIVARIATE ANALYSIS OF PARAMETERS RELATED TO LAKE ACIDIFICATION IN QUEBEC,**
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
B. Bobee, and M. Lachance.
Water Resources Bulletin, Vol. 20, No. 4, p 545-556, August, 1984. 7 Fig, 5 Tab, 26 Ref.

Descriptors: *Lake acidification, *Quebec, *Multivariate analysis, Canadian shield, Acid rain, Acidification, Lakes.

Multivariate methods were used for the statistical analyses both of Quebec as a whole and of the shield area, based on physico-chemical data from 234 lakes collected during the spring and summer of 1980. A statistical method, based on the joint use

of factorial correspondence analysis and cluster analysis, was applied to these data to obtain a general picture of the spatial variability of a number of physico-chemical parameters related to the sensitivity or acidification of lakewaters. The part of Quebec lying on the Canadian shield is especially vulnerable to acidification. The southwestern portion of this area of Quebec was more substantially affected by acid fallout. A detailed study of spatial variability over the shield area revealed the existence of greater spatial heterogeneity. It was possible to pinpoint zones which are highly vulnerable to acid precipitation and zones whose lakes show clear signs of acidification resulting from such precipitation. The results of these statistical analyses should also affect the design of future sampling surveys. They delimit the regions where network density needs to be increased if a more accurate description of the spatial variability of the acidification is sought. (Moore-IVI)
W85-02981

**EIGENVALUE TECHNIQUE FOR SOLUTE TRANSPORT,**
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
J. C. Hwang, R. M. Koerner, W. C. Cho, and K. S. Yeung.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1302-1314, October, 1984. 1 Fig, 1 Tab, 18 Ref, 2 Append.

Descriptors: *Solute transport, *Path of pollutants, *Eigenvalue technique, Groundwater pollution, Modelling, Groundwater management, Boundary conditions, Computer programs.

Detailed procedures are presented for applying the eigenvalue technique to solutions of the linear equation for solute transport in groundwater. The time invariant boundary conditions generally encountered in groundwater contamination problems are concentrated sources, impermeable boundaries, boundaries with known influx and outward flow-through boundaries with vanishing normal concentration gradient. Time dependent boundary conditions are excluded. Using the eigenvalue technique the dynamic system equation is decoupled and the time integration can be done independently and continuously for each nodal point. An explicit expression is obtained for each nodal point as a function of time. The Eispack computer package can be used to calculate a general real matrix, whether it is symmetric or asymetric, with satisfactory results. The computed results that use the eigenvalue technique for solving a 2-D groundwater solute transport problem compare well with the analytic solution. This method can provide convenience of data retrieval, particularly in groundwater management modeling. (Moore-IVI)
W85-03004

**POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN SEDIMENTS FROM SISKIWIT LAKE, ISLE ROYALE,**
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. M. Czuczwa, B. D. McVeety, and R. A. Hites.
Science, Vol. 226, No. 4674, p 568-569, November, 1984. 1 Tab, 13 Ref.

Descriptors: *Path of pollutants, *Lake sediments, *Siskiwit Lake, *Isle Royale, *Michigan, *Dibenzo-p-dioxins, *Dibenzofurans, Organic compounds, Incineration, Dioxins, Furans, Air pollution, Water pollution sources.

Dioxins and dibenzofurans have several sources and can thus enter the environment either through the atmosphere or through the water. The atmospheric path was investigated by measuring polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in sediments from Siskiwit Lake, located on Isle Royale in northern Lake Superior. Three sediment cores taken from sections of Siskiwit Lake indicate that octachlorodioxin (OCDD) predominates, and the heptachlorodioxins (HpCDD) and the heptachlorofurans (HpCDF) are also abundant cogeners. These findings suggest that PCDD and PCDF are ubiquitous environmental contaminants that are transported through the atmosphere much in the same way as pesticides and certain heavy metals. The most significant source of PCDD and PCDF to the atmosphere is the combustion of wastes that contain chlorinated compounds. (Baker-IVI)
W85-03025

**STUDIES ON A SELECTED INDUSTRIAL EFFLUENT AND THE RECEIVING STREAM,**
Ife Univ. (Nigeria). Dept. of Civil Engineering.
O. Ogedengbe, H. O. Fapohunda, and M. B. Gotau.
Water International, Vol. 9, No. 2, p 58-61, 1984. 3 Tab, 6 Ref.

Descriptors: *Industrial wastes, *Waste disposal, *Wastewater treatment, *Water quality, *Nigeria, *Ona River, Water management, Decision making, Planning, Developing countries.

Efforts at producing water quality standards have been largely unsuccessful in many developing countries. Attempts to establish such standards in Nigeria are reviewed. Nigeria has some very large rivers around which it has established a number of River Basin Authorities. While the waters in these rivers used to be clean, recent advancements in several industries have changed this situation. Effuents from bottling and canning factories have impaired the quality of Ona stream to such an extent that the water is unsuitable for irrigation or for any other use. The canning waste is amenable to biological treatment, preferably aerobic, or possibly facultation. Studies are continuing to determine just what approach will be used to solve this problem. It is essential in such areas that specific conditions for water to be used must be defined in the future such as crops being grown, soil properties and others. No plant should be constructed unless, and until there is proof, that it would make a positive difference to downstream waters. (Baker-IVI)
W85-03027

**WATER - THE SILENT MESSENGER BETWEEN CAUSE AND EFFECT IN ENVIRONMENTAL PROBLEMS,**
Swedish Natural Science Research Council, Stockholm.
M. Falkenmark.
Water International, Vol. 9, No. 2, p 62-65, 1984. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality control, *Planning, Decision making, Water management, Developing countries.

An array of meetings to discuss the environmental problems emerging for the 80s have been held during the 10 year period after the Stockholm Conference on the Human Environment. Several ten year anniversary celebrations included presentations of overviews on progress and concerns which have been addressed during the interim period. One crucial advancement has been the increasing role of public awareness. The role of water most frequently mirrored in environmental discussions is water as a physical environment. However, a second role, invisible, but of extreme importance, is the role of water as a carrier of solutes and sediments. The third role of water is its action as a local vector tying together land and water. This function implies that many of man's activities at the ground surface will sooner or later be reflected in the groundwater or in the river system. A fourth role of extreme importance for the human environment is the role as disease vector, transmitting pathogens of various kinds from various sources and along different pathways. A fifth role is the physiological role of water as a basic substance for support of body functions or living beings including heat balance and tissue stiffening, unbalance having far reaching impacts on health and well being. (Baker-IVI)
W85-03028

**MERCURY POLLUTION IN MARINE SEDIMENTS NEAR A CHLORALKALI PLANT: DISTRIBUTION AND AVAILABILITY OF THE METAL,**
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
F. Baldi, and R. Bargagli.
Science of the Total Environment, Vol. 39, No. 1/2, p 15-26, October, 1984. 3 Fig, 6 Tab, 28 Ref.

Descriptors: *Mercury, *Fate of pollutants, *Marine sediments, *Tyrrhenian Sea, *Italy, Heavy metals, Cinnabar, Industrial wastes, Water pollution sources, Sinks, Marine pollution.

Sediments near the chlor-alkali plant of Rosignano Solvay, Tuscany, were collected and examined for mercury content. The distribution of mercury in marine sediments of the Tyrrhenian continental shelf showed that the area just off the chlor-alkali plant gave the highest values of the whole sampling zone, 4.06 micro g/g. A few stations to the north of Piombion registered values of 1 micro g/g which is perplexing as neither industries nor cinnabar deposits are associated with this zone. The significant concentrations of mercury in the southernmost part of the sampling area can be explained by the Albegna and Ombrone river outflows, since both rivers drain the cinnabar deposits and the mercury mining area of Mount Amiata. The concentrations on the inner continental shelf are in general greater than 0.5 micro g/g. Only a few stations, located on the outer shelf and near the mouth of the Arno River, have background values. Sequential leaching studies suggest that marine sediments off the chlor-alkali plant are a good sink for mercury and chemico-physical changes of the marine environment cannot easily remove this element into the water column. Hence, the mercury of the sediment shoul not be able to enter into the food chain. The lack of agreement of this finding with those of earlier studies indicates that the sequential leaching technique is not an adequate approach for testing the availability of mercury, which undergoes microbial transformations. (Baker-IVI)
W85-03030

**CHLORINATED CONTAMINANTS IN THE NIAGARA RIVER, 1981-1983,**
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and K. D. Nicol.
Science of the Total Environment, Vol. 39, No. 1/2, p 57-70, October, 1984. 4 Fig, 6 Tab, 19 Ref.

Descriptors: *Water analysis, *Niagara River, *Chlorinated hydrocarbons, *Niagara-on-the-Lake, *Ontario, *Lake Erie, Organic compounds, Pesticides, Agricultural chemicals, Rainfall, Runoff.

Large volume (16 liter) water samples were collected weekly from the Niagara River at Niagara-on-the-Lake and analyzed for 31 chlorinated contaminants for the period September 1981 to September 1983. The analysis of water at the source (Lake Erie) of the Niagara River at Fort Erie and at the river mouth at Niagara-on-the-Lake shows that significant inputs of contaminants to the river are occurring. At least an order of magnitude increase in the concentration of chlorobenzenes takes place over the river's course. Many halogenated compounds not detected at Fort Erie were readily detected at Niagara-on-the-Lake. A significant amount of the PCBs and pesticides in the river may originate in Lake Erie. The most predominant class of halogenated compounds in the river appears to be the chlorobenzenes. A fairly steady background concentration was observed for most compounds, likely due to steady leaching from waste disposal sites along the river's course. Superimposed on these background levels were numerous unpatterned concentration spikes, indicating direct dumping into the river. Only crude estimates of contaminant loadings from the Niagara River to Lake Ontario could be made because of the large concentration variability in the river. (Baker-IVI)
W85-03033

**SOLUTE TRANSPORT IN HETEROGENEOUS POROUS FORMATIONS,**
Tel-Aviv Univ. (Israel). Faculty of Engineering.

For primary bibliographic entry see Field 2F.
W85-03036

**STOCHASTIC APPROACH TO MODELS FOR THE LEACHING OF ORGANIC CHEMICALS IN SOIL,**
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
H. Gydesen.
Ecological Modelling, Vol. 24, No. 3/4, p 191-205, September, 1984. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Stochastic process, *Model studies, *Organic compounds, *Soil leaching, Diffusion, Statistical analysis, Leaching, Path of pollutants.

A common way to study the movement of a chemical in a given soil type is to set up soil columns of a given length, apply a chemical and pass a known water flow through the column. One approach to modelling the results of such an experiment is to use a deterministic model, formulated as a partial differential equation for the concentration of the chemical interpreted as a function of both time and position. A procedure is given to determine whether leaching data from a given experiment can be said to follow the basic diffusion model. The underlying principle is that it is valuable to attempt the simplest model first. Thus if the data fit the the simple model well, then a more complicated model is unnecessary, and the use of a more general model may overinterpret existing data. If the basic model describes the data satisfactorily, statistical tests for hypotheses concerning homogeneity or linearity of different chemical or soil columns may be developed. (Moore-IVI)
W85-03076

**RELATIONSHIP BETWEEN ATMOSPHERIC NITROGEN DEPOSITION AND THE STREAM NITROGEN PROFILE,**
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
M. D. Moore, and J. R. Nuckols.
Journal of Hydrology, Vol. 74, No. 1/2, p 81-103, October, 1984. 2 Fig, 7 Tab, 34 Ref.

Descriptors: *Nitrogen, *Water pollution sources, *Atmospheric deposition, *Little Millseat watershed, *Kentucky, West Fork Walker Branch watershed, *Tennessee, Linear regression analysis, Forest watersheds, Water chemistry, Streams, Organic nitrogen, Acid rain.

Linear regression analysis techniques were used to study the relationship between the stream nitrogen chemistry profile and atmospheric deposition of nitrogenous compounds to two small forested watersheds linear. The 81.7-ha Little Millseat (LM) and 38.4-ha West Fork Walker Branch (WFWB) watersheds are located in eastern Kentucky and eastern Tennesee, respectively. Both are characterized by steep slopes. Vegetation in the watersheds consists predominantly of the oak-hickory type, and soils have moderately rapid permeabilities. Precipitation on the WFWB watershed is evely distributed throughout the year, whereas in the LM watershed it peaks in late winter and is lowest in late summer. A relationship exists between atmospheric deposition of nitrogen compounds and stream nitrogen chemistry in these watersheds. It is highly dependent on the hydrologic response potential of the watershed. Measured levels of atmospheric deposition of nitrogen compounds in the wetfall to the LM and WFWB watersheds were significantly above values reported in other studies. The proximity of the watersheds to pollution sources, such as fossil fuel combustion power stations and surface-mining sites, appeared to be a major factor contributing to these differences. Organic-nitrogen was measured in significant quantities for both watersheds and should be considered as a major input parameter for future depositional research in the study region. (Moore-IVI)
W85-03084

**EFFECTS OF SIMULATED ACID PRECIPITATION ON DECOMPOSITION AND LEACHING OF ORGANIC CARBON IN FOREST SOILS,**
Bemidji State Univ., MN. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W85-03095

**CADMIUM SORPTION AND MOBILITY IN SLUDGE-AMENDED SOIL,**
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5E.
W85-03097

**CHARACTERISTICS OF AUTOPURIFICATION IN THE OSSAM RIVER, A TRIBUTARY OF THE DANUBE (EINIGE BESONDERHEITEN IN DER SELBSTREINIGUNG DES DONAUZUFLUSSES OSSAM),**
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
B. K. Russev, I. J. Janeva, and R. B. Detcheva.
Hydrobiology (Bulgarian Academy of Science), Vol. 21, p 14-28, May 1984. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Ossam River, *Bulgaria, *Autopurification, *Fate of pollutants, *Biodegradation, Microbial degradation, Macrobenthos, Wastewater disposal, Dissolved oxygen, Water temperature, Saprobic conditions.

The autopurification capacity of the Ossam River, a tributary of the Danube in Bulgaria, below the cities of Troyan and Lovec was studied. In order to achieve this, it was important to establish a relationship between oxygen saturation on the river bottom and on the surface and the quantitative development of Ciliata in stony deposits and sludge, the macrozoobenthos composed of the lithorheophilic zoozonose, and the saprobic condition of the river. These parameters were measured in the Ossam in March, May and September 1978. Results showed that oxygen content in water at the surface and on the bottom was not the same despite a relatively high degree of turbulence in the shallow (< 0.5 m) river. Greater or lesser differences in oxygen content/saturation between the surface and the bottom reflected a respectively greater or lesser degree of pollution. A correlation was observed between Rothschein's saprobiological index (indicating the saprobic condition and autopurification processes on the basis of the macrozoobenthos) and oxygen content/saturation at the bottom and, to a lesser extent, at the surface. The maximal effect of autopurification occurs when the destruction of organic bottom sediment is largely accomplished or, in other words, when oxygen saturation near the bottom increases sharply and approaches that of the surface. The effects of pollution, expressed by the saprobiological index, are most intense not at the site of wastewater discharge but several kilometers downstream. Comparable studies of pollution and autopurification of the Ossam conducted in 1968-1969 and 1971-1972 showed that both pollution and the level of autopurification were greater in 1968-1969 than in 1971-1972 or 1978. In 1978, the number of hydrobiological organisms was greatly decreased despite a low level of pollution and better autopurification. Autopurification was significantly less effective in March than in May or September, probably due to lower temperatures and correspondingly less hydromicrobiological activity. (Gish-IVI)
W85-03100

**CHANGING MACROINVERTEBRATE COMMUNITY STRUCTURE AND DIVERSITY IN AN ORGANICALLY LOADED RIVER DURING ITS SELFPURIFICATION,**
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5C.
W85-03101

**BIOLOGICAL STATE OF UNDERGROUND WATERS IN THE INDUSTRIAL ZONE OF THE EASTERN PART OF THE SOFIA PLAIN (BIOLOGICHIO S'STOYANIE NA PODZEMNITE VODI V INDUSTRIALNATA ZONA NA UZTOCHNOTO ZOFIIZKO POLE),**
A. A. Petrova, E. B. Angelkova, and R. L. Tsvetkova.
Hydrobiology, Vol. 21, p 42-55, May, 1984. 1 Fig, 6 Tab, 9 Ref.

Descriptors: *Sofia Plain, *Bulgaria, *Groundwater pollution, Bacteria, Domestic wastes, Industrial wastes, Agricultural wastes, Wastewater.

The groundwaters most strongly affected by industry, agriculture and households in the Eastern Sofia Plain (Bulgaria) were studied. A general background pollution level and some cases of local household pollution by private and co-operative farms without sewage were established. The bacteriological and stygobiological evidence showed no toxic pollution. (Author's abstract)
W85-03103

**MICROBIOLOGICAL SURVEY ON THE EFFECT OF THE BLAGOEVGRADSKA BISTRITSA RIVER ON THE STRUMA RIVER WATER QUALITY (MIKROBIOLOGICHNO IZSLEDVANE NA VLIYANIETO NA REKA BLAGOEVGRADSKA BISTRITSA V'RKHU KACHESTVOTO NA VODATA NA REKA STRUMA),**
S. M. Naumova, and T. P. Todorov.
Hydrobiology (Bulgarian Academy of Science), Vol. 22, p 25-38, June, 1984. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Microorganisms, *Blagoevgradska Bistritsa River, *Struma River, *Water quality, Bacteria, Seasonal variation, Razumov index, Organic matter, Water pollution, Biodegradation.

Below the point of inflow of the Blagoevgradska Bistritsa river into the Struma river, the total count of microorganisms after Razumov increases 1.3 fold in spring, 1.5 fold in summer and 4.1 fold in fall. The morphological index (the ratio between rod-like and cocci-like bacterial cells) reaches its highest value in summer (1.7 fold) while in spring and fall it is much lower. The number of oligocarbophiles grows 1.2 fold in spring, 1.5 fold in summer and 3.8 fold in fall. Their relative share slightly diminishes in spring, strongly - in summer and somewhat - in fall. The c.f.u. number just under the point of inflow grows 1.4 fold in spring, 2.2 fold in summer and 5.4 fold in fall while the Razumov index reaches its highest value in summer. The number of the spores of heterotrophs is low and follows the c.f.u. number variation pattern with their share growing in fall. The Struma river microflora is oligocarbophilic but under the influence of the Blagoevgradska Bistritsa the amount and significance of the carbophilic components increases. Biodegradation of organic matter in the Struma below the inflow of the Blagoevgradska Bistritsa, even having been intensified, does not reach the final stage of mineralization. The Struma microbiological indices are altered considerably by the strongly organically polluted Blagoevgradska Bistritsa and its microflora. The strongest negative effect of the Blagoevgradska Bistritsa is observed in summer and the lowest, in spring. In 1980 when the water levels of both rivers were very low the strongest polluting effect of the Blagoevgradska Bistritsa was observed. However 12 km downstream the effect of the latter is overcome and the Struma river water quality is completely restored. (Author's abstract)
W85-03105

**HYDROBIOLOGICAL AND SAPROBIOLOGICAL ALTERATIONS IN THE TUNJA RIVER. I. 1955 - 1967 (TENDENTSII V IZMENENIYATA NA KHIDROBIOLOGICHNOTO I SAPROBIOLOGICHNOTO S'STOYANIE NA REKA TUNDZHA. I. 1955-1967 G),**
B. K. Russev, M. I. Nikolova, and M. A. Dimitrova.
Hydrobiology (Bulgarian Academy of Science), Vol. 22, p 59-73, June, 1984. 2 Fig, 2 Tab, 20 Ref.

Descriptors: *Tunja River, *Bulgaria, *Saprobity, *Aquatic life, Water pollution effects, Aquatic insects, Benthic flora, Algae, Invertebrates, Water level, Resuspension, Organic matter, Hydrologic aspects.

A total of 237 hydrobionts were found in 14 locations along the river in 1955, 1966 and 1967. Thirty nine benthic algae (18 Bacillariophyta and 16 Chlorophyta) and 198 benthic invertebrates (55 Ephemeroptera, 36 Chironomidae, 22 Trichoptera, 16 Odonata, etc.) were established. In 1955 the entire river was in a good saprobiological condition with the lowest saprobiological index being 46.64 (beta-mesosaproby) indicating that the river was near the normal, nonpolluted condition. In 1966 alpha-mesosaproby was established near Kazanluk and in 1967 - after the point of inflow of the Asenovitsa river and the Yambol waste water. However, at the state border the river was in beta-mesosaproby during all three years. In 1967 in 55% of the cases of changes in the water level, directly proportional changes in the saprobiological index occurred and in 45% these changes were inversely proportional indicating that improved saprobiological conditions were observed more frequently when the water level went up mostly because of the dilution of organic pollutants. The inverse correlation may be due to the stronger effect of pollution compared to the higher water level, the washing off of bottom clay and sedimented pollutants by rapidly increasing flow rates thus increasing the amounts of resuspended organic substances as well as by the carrying away of insect larvae and other benthic organisms by the high flow rates and thus altering the structures of benthic cenoses and the saprobiological river characteristics. Further studies on the correlation between the saprobiological index and the water amounts are needed during the period of high water level. (Author's abstract)
W85-03106

**HEAVY METALS IN A CONTAMINATED AUSTRALIAN ESTUARY - DISPERSION AND ACCUMULATION TREND,**
Aix-Marseille-1 Univ. (France).
P. S. Roy, and E. A. Crawford.
Estuarine, Coastal and Shelf Science, Vol. 19. No. 3, p 341-358, September, 1984. 7 Fig, 4 Tab, 44 Ref.

Descriptors: *Estuaries, *Heavy metals, *Dispersion, *Accumulation, *Lake Macquarie, *Australia, Zinc, Lead, Copper, Cadmium, Manganese, Nickel, Cobalt, Silver, Iron, Estuarine sediments, Lagoons, Fate of pollutants, Bioturbation.

Very high concentrations of Zn, Pb, Cu and Cd occur in the muddy bottom sediments of Lake Macquarie, a saline coastal lagoon in southeastern Australia. The trace metals emanate from industrial sources, especially a lead-zinc smelter, at the northern end of the lake. Individual metal concentrations decrease progessively away from the source area but at differing rates; Zn is most mobile and Cd appears to be deposited first. They approach natural background levels in the southern part of the lake. Mn shows a reverse trend but Ni, Co, Ag and Fe rarely rise above background levels. Shallow cores in the lake bed penetrated a metal enriched surface zone 15-35 cm thick underlain by uncontaminated sediments with natural (background) metal concentrations. Sedimentation rates determined from radiocarbon ages on shells in the cores mainly range between 0.15 and 0.5 mm/yr. Over the 85 years since industrialization commenced, less than 5 cm of mud has accumulated on the lake bed. Bioturbation is invoked to account for the depth to which the sediment has been enriched in heavy metals. (Author's abstract)
W85-03109

**MINERAL SUBSTANCES OF AQUATIC AND TERRESTRIAL VEGETATION IN THE STORAGE TANK AT KISKORE,**
Allatorvostudomanyi Egyetem, Budapest (Hungary).
Gy. Tolgyesi, and A. Kozma.
Tiscia (Szeged), Vol. 19, No. 2, p 157-163, 1984. 2 Tab, 10 Ref.

Descriptors: *Aquatic plants, *Littoral plants, *Kiskore, *Hungary, Potassium, Phosphorus, Sulfur, Magnesium, Sodium, Aluminum, Iron, Manganese, Zinc, Copper.

On June 30, 1982, 18 water plant samples were collected from the water of the Kiskore storage tank, and 54 littoral vegetation samples were collected from the sides of a canal. The 72 plant specimens were analyzed for 11 elements: K, Ca, P, S, Mg, Na, Al, Fe, Mn, Zn and Cu. For the more critical elements the averages of the 54 terrestrial specimens were as follows: P = 2.0 g/kg, Mg = 1.9 g/kg, Na = 0.8 g/kg, Zn = 42.6 mg/kg and Cu = 7.5 mg/kg. The littoral vegetation is in every respect of normal composition. At the time of the study, both the aquatic and terrestrial vegetation contained the mineral substances in the customary concentration. The values can be regarded as essentially basic values to which future data can be compared. (Moore-IVI)
W85-03119

**BLACK ACIDIC SNOW IN THE REMOTE SCOTTISH HIGHLANDS,**
University of East Anglia, Norwich (England). School of Environmental Sciences.
T. D. Davies, P. W. Abrahams, M. Tranter, I. Blackwood, and P. Brimblecombe.
Nature, Vol. 312, No. 5989, p 58-61, November 1984. 3 Fig, 2 Tab, 46 Ref.

Descriptors: *Acidic snow, *Scotland, *Acid deposition, *Snow, Chemistry of precipitation, Hydrogen ion concentration, Snowpack, Acidic flushes, Water pollution sources, Fate of pollutants.

Parts of Scotland experience large acidic depositions which may result in ecological damage. Some highland areas appear to suffer enhanced acidic input which frequently exhibits pronounced episocidicity. Acidic snowfall leads to acidic flushes during snow-pack melting. Polluted grey snow layers have been previously reported in Scandinavia. The distinctive black, acid snowfall episode with pH 3.0, reported here, is the first documented case remote from major pollution sources. The particulate deposit was very large and consisted of approximately 29% carbon; the remaining fraction included particles which could be identified as coal fly-ash. The heavily polluted air originated to the south-south east and was probably transported at an altitude of approximately 1,000-1,500 m in association with a stable atmospheric layer whereupon particles were efficiently scavenged by snow. Such transport and deposition mechanisms may produce the greater pollutant deposition sometimes observed in mountain areas. Similar events may not be rare and could make an important contribution to the annual pollutant input. (Author's abstract)
W85-03127

**INTERVENTION ANALYSIS OF WATER QUALITY RECORDS,**
Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
For primary bibliographic entry see Field 7B.
W85-03131

**HYDROGEOCHEMICAL INTERACTION BETWEEN A MUNICIPAL WASTE STABILIZATION LAGOON AND A SHALLOW AQUIFER,**
North Dakota Univ., Grand Forks. Dept. of Geology.
For primary bibliographic entry see Field 5G.
W85-03154

**AMMONIUM ION, HUMIC MATERIALS, AND TRIHALOMETHANE POTENTIAL IN NORTHEASTERN KANSAS GROUND WATERS,**
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2K.
W85-03155

**ANALYSIS OF DISPERSION IN A STRATIFIED AQUIFER,**
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W85-03160

**MODEL FOR INVESTIGATING MECHANICAL TRANSPORT IN FRACTURE NETWORKS,**
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W85-03163

**INCORPORATION OF TRIVALENT CHROMIUM INTO RIVERINE AND ESTUARINE COLLOIDAL MATERIAL,**
Maine Univ. at Orono, Walpole. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W85-03206

**SEASONAL VARIATIONS OF 210-PB AND 210-PO CONCENTRATIONS IN AN OLIGOTROPHIC LAKE,**
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 2H.
W85-03212

## 5C. Effects Of Pollution

**TOXICOLOGICAL INVESTIGATION AND EVALUATION OF DRINKING-WATER POLLUTION CAUSED BY CHEMICAL WASTES,**
Orszagos Kozegeszegugyi Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 5F.
W85-02696

**EFFECTS OF 2,4-DICHLOROPHENOXYACETIC ACID IN ARTIFICIAL ACID RAIN ON BRASSICA NAPUS AND SINAPIS ALBA,**
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
H. Lokke.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 328-338, August, 1984. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Acid rain, *Herbicides, *Rape, *Mustard, *Dichlorophenoxyacetic acid, Plant growth, Herbicides, Water pollution effects.

The effect of 2,4-dichlorophenoxyacetic (2,4-D) acid in artificial rain at pH 3.3 was examined for young plants of rape (Brassica napus L.) and white mustard (Sinapis alba L.). Plants were treated in a closed simulation chamber system with varying CO2 supply (198-418 ppm). Single or daily showers were applied for 20-30 min at varying 2,4-D concentrations (0, 0.03, 0.1, 0.5, and 2.5 mg/l). The plants were sampled 5 days after the last treatment. Epinasty was observed for Brassica at 0.5 mg/l and for Sinapis at 0.1 mg/l 2,4-D. Leaf to stem dry weight ratios increased with increasing CO2 concentrations in the air and decreased following single treatments with 0.5 or 2.5 mg/l 2,4-D in the rain. Dose-effect relationships are proposed for both plant species. Leaf dry matter weights per area unit decreased with increasing CO2 concentrations, but were not significantly affected by the 2,4-D treatments. (Author's abstract)
W85-02697

**ENVIRONMENTAL MODEL SEGMENT APPROACH FOR ESTIMATING POTENTIAL ENVIRONMENTAL CONCENTRATIONS, I. THE MODEL,**
Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W85-02699

**ENVIRONMENTAL MODEL SEGMENT APPROACH FOR ESTIMATING POTENTIAL ENVIRONMENTAL CONCENTRATIONS, II. APPLICATION OF THE MODEL TO P-DICHLOROBENZENE AND TRICHLOROETHENE,**
Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W85-02700

**EFFECTS OF CADMIUM-ENRICHED SEDIMENT ON FISH AND AMPHIBIAN EMBRYO-LARVAL STAGES,**
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
P. C. Francis, W. J. Birge, and J. A. Black.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 378-387, August, 1984. 2 Fig, 4 Tab, 33 Ref.

Descriptors: *Cadmium, *Sediment contamination, *Immature growth stages, *Goldfish, *Frogs, *Bass, Heavy metals, Water pollution effects, Mortality, Bioaccumulation, Toxicity.

Aquatic toxicity tests were conducted to evaluate the effects of cadmium-enriched sediment on embryo-larval stages of the goldfish (Carassius auratus), leopard frog (Rana pipiens), and largemouth bass (Micropterus salmoides). Natural stream sediment was collected and enriched with cadmium to nominal concentrations of 1.0, 10.0, 100 and 1000 mg/kg. Enriched sediments were placed on Pyrex dishes and covered with 350 ml of reconstituted water. Fertilized eggs were placed in the dishes and maintained through 4 days posthatching, giving a total exposure time of 6 to 7 days. For all tests the cadmium concentrations ranged from 1.1 to 76.5 micro g/liter in water above sediments containing 1 to 1000 mg Cd/kg, respectively. Although low frequencies of mortality were observed in all tests, goldfish, leopard frog, and bass exposed to sediments enriched to 1000 mg Cd/kg accumulated 4.61, 12.55, and 60.0 micro g Cd/g, respectively. No significant correlations ($P < 0.05$) were found between mortality of the goldfish and leopard frog and the cadmium concentrations in either water or sediment. However, all three species showed strong correlations ($r >$ or $= 0.98$) between cadmium concentrations in water and tissue, sediment and tissue, and water and sediment. Tissue cadmium concentrations were related to the length of time test organisms were in direct contact with cadmium-enriched sediment. (Author's abstract)
W85-02701

**QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS AND MIXTURE TOXICITY STUDIES OF CHLORO- AND ALKYLANILINES AT AN ACUTE LETHAL TOXICITY LEVEL TO THE GUPPY (POECILIA RETICULATA),**
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
J. Hermens, P. Leeuwangh, and A. Musch.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 388-394, August, 1984. 5 Tab, 19 Ref.

Descriptors: *Structure-activity relationships, *Toxicity, *Anilines, *Guppy, Octanol partition coefficient, Hydrophobicity, Electronic properties, Chloroanilines, Alkylanilines.

Correlations were calculated between the acute lethal toxicity to the guppy (Poecilia reticulata) of a series of anilines (chloro- and alkylanilines) with different characteristics of hydrophobicity (calculated and experimental octanol partition coefficients and Π constants) together with Hammett sigma constants. Quantitative structure-activity relationships (QSARs) were determined. The acute lethal toxicity of anilines to guppies is a function of the hydrophobic and electronic properties of these compounds because a QSAR with octanol partition coefficient and Hammett constants yielded a significant better correlation than octanol partition coefficient alone. The three characteristics of hydrophobicity result only in small differences in the calculated QSARs. Only the correlations between the three hydrophobicity characteristics and the Hammett constants influence the statistical reliability of the improvements of the QSARs with Hammet constans as parameter. The toxicities of mixtures of the anilines corresponded to concentration addition. (Moore-IVI)
W85-02702

**CRITICAL REVIEW OF EPIDEMIOLOGIC STUDIES RELATED TO INGESTED ASBESTOS,**
Pittsburgh Univ., PA. Dept. of Biostatistics.
G. M. Marsh.
Environmental Health Perspectives, Vol. 53, p 49-56, November, 1983. 7 Tab, 25 Ref.

Descriptors: *Water pollution effects, *Epidemiology, *Asbestos, Cancer, Mortality, Carcinogens, Human diseases, Public health.

Thirteen epidemiologic studies of ingested asbestos conducted in five areas of the US and Canada were evaluated for the definitiveness and applicability regarding the development of ambient water quality standards. Associations between asbestos in water supplies and cancer mortality or incidence in humans were found in one or more studies dealing with neoplasms in the esophagus, stomach, small intestine, colon, rectum, gallbladder, pancreas, peritoneum, lungs, pleura, prostate, kidneys, brain and thyroid as well as leukemia. However, no single study nor aggregate of studies existed that would establish risk levels from ingested asbestos. It is recommended that the integrated ecologic data to date be used to generate a rough priority of specific etiologic hypotheses that should be tested in the original settings or in independent study populations using studies designed at the more definitive individual level, such as case-control studies. (Baker-IVI)
W85-02704

**CANCER RISK FROM ASBESTOS IN DRINKING WATER: SUMMARY OF A CASE-CONTROL STUDY IN WESTERN WASHINGTON,**
Fred Hutchinson Cancer Research Center, Seattle, WA.
L. Polissar, R. K. Severson, and E. S. Boatman.
Environmental Health Perspectives, Vol. 53, p 57-60, November, 1983. 20 Ref. EPA grant 805846.

Descriptors: *Asbestos, *Carcinogens, *Epidemiology, *Drinking water, *Sultan River, *Everett, *Washington, Human diseases, Public health, Water quality control, Chrysotile, Water pollution effects.

A case-controlled, interview-based study of the risk of developing cancer from asbestos in drinking water was conducted. Cases and controls were selected from the Everett, Washington, area which has used the Sultan River as a source of drinking water since 1918. Sultan River tapwater has concentrations of chrysotile asbestos around 200 million fibers/liter. Through a population based tumor registry, 382 individuals with cancer of the buccal cavity, pharynx, respiratory system, digestive system, bladder, or kidneys, diagnosed between 1977 and 1980, were identified. Data on asbestos exposure were collected based on residence and workplace history, and on individual water consumption. Logistic regression was used to estimate cancer risk. Summarizing the findings for imbibed asbestos, very few elevated risks of statistical significance were found. Considering the relative risk for each of the sites and for each of the four asbestos exposure variables, no instance was found in which the risk was elevated for both males and females. The only statistically significant elevated risks occurred for male pharynx and male stomach. (Baker-IVI)
W85-02705

**OBSERVATIONS OF CANCER INCIDENCE SURVEILLANCE IN DULUTH, MINNESOTA,**
Minnesota Dept. of Health, Minneapolis.
E. E. Sigurdson.
Environmental Health Perspectives, Vol. 53, p 61-67, November, 1983. 5 Tab, 19 Ref.

Descriptors: *Human diseases, *Asbestos, *Drinking water, *Epidemiology, *Duluth, *Minnesota, Water quality control, Water supply, Carcinogens, Amphibole, Public health, Cancer.

Amphibole asbestos fibers were discovered in the municipal water supply for Duluth, Minnesota in 1973. From the late 1950s through 1976 the entire city population of about 100,000 persons was exposed to asbestos at levels of 1-65 million fibers per liter of water. Surveillance of cancer incidence in the area was initiated to determine the health effect from asbestos ingestion. While statistically significant excesses are present in several primary cancer sites in Duluth residents, lung cancer in Duluth females is the only primary site considered also of biological significance. The mesothelioma incidence was no more than expected. Problems of long-term surveillance of exposed populations considered at risk of environmental cancer are defined and the need for improved study methodologies is emphasized. Use of federal records for follow up of exposed individuals is suggested. (Baker-IVI)
W85-02706

**EFFECT OF POPULATION DENSITY ON THE RESULTS OF THE STUDY OF WATER SUPPLIES IN FIVE CALIFORNIA COUNTIES,**
California Univ., Berkeley. Group in Biostatistics.
P. M. Conforti.
Environmental Health Perspectives, Vol. 53, p. 69-78, November, 1983. 13 Tab, 4 Ref. EPA grant C2455NTET.

Descriptors: *Asbestos, *Population density, *Epidemiology, *San Francisco, *California, *Drinking water, Cancer, Epidemiology, Water pollution effects, Public health, Human diseases, Chrysotile, Carcinogens.

The association between cancer incidence and chrysotile asbestos ingested through drinking water in the San Francisco-Oakland Standard metropolitan Statistical Area (SMSA) was investigated in two previous studies in 1969-1971 and 1969-1974. An important covariable in the association between cancer and environmental agents, population density, was not included in the analyses of these studies. The original and reanalyzed results are compared to reassess the association between cancer and asbestos. The only change in the regression procedures of the original studies was the addition of population density as an independent variable in the reanalysis. The inclusion of population density in the analysis had little effect on the results. Therefore, the conclusion is that a positive association between ingested asbestos and cancer existed in the San Francisco-Oakland SMSA for 1969-1974 for certain cancer sites. The associations observed in these analyses are indirect, the number of cancers is small for the number of body sites studied, and the 35 body sites analyzed were not independent. It is recommended that more research of a direct nature be done regarding digestive cancers and ingested asbestos. (Baker-IVI)
W85-02707

**GRAPHICAL ANALYSIS OF THE INTERRELATIONSHIPS AMONG WATERBORNE ASBESTOS, DIGESTIVE SYSTEM CANCER AND POPULATION DENSITY,**
California Univ., Berkeley. Dept. of Biomedical and Environmental Health Sciences.
M. E. Tarter, R. C. Cooper, and W. R. Freeman.
Environmental Health Perspectives, Vol. 53, p 79-89, November, 1983. 25 Fig, 24 Ref. NCI grant 1 RO1 CA 28142-01A2, EPA contract 68033130.

Descriptors: *Asbestos, *Population density, *Drinking water, *Cancer, *Epidemiology, San Francisco, California, Statistical studies, Carcinogens, Public health, Human diseases.

Five statistical procedures were used to partial the correlation between waterborne asbestos and digestive site cancer for the putative effects of population density. These include: analysis based on a data subset with roughly homogeneous population density; standard residual analysis (partial correlation); conditional probability integral transformation; analysis based upon ranked data, and use of logarithmic transformation. To examine the nature or shape of the asbestos-cancer dose-response curve, nonparametric regression graphical techniques are applied. There appears to be a considerable difference between analyses involving non-high-density tracts and non-San Francisco tracts. Evidence is also presented that the modal-type nonparametric regression curve forks or bifurcates when adjustment is made for population density. (Baker-IVI)
W85-02708

**EPIDEMIOLOGY STUDY OF THE USE OF ASBESTOS-CEMENT PIPE FOR THE DISTRIBUTION OF DRINKING WATER IN ESCAMBIA COUNTY, FLORIDA,**
Environmental Protection Agency, Cincinnati, OH. Toxicology and Microbiology Div.
J. R. Millette, G. F. Craun, J. A. Stober, D. F. Kraemer, and H. G. Tousignant.
Environmental Health Perspectives, Vol. 53, p 91-98, November, 1983. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Asbestos cement, *Pipes, *Drinking water, *Epidemiology, *Escambia County, *Florida, Public health, Human diseases, Cancer, Water pollution effects, Mortality, Asbestos, Carcinogens.

Cancer mortality for the population census tracts of Escambia County, Florida was compared with cancer mortality data collected from census tracts elsewhere within the same county. In the first group asbestos-cement (AC) pipe was used for public potable water distribution. In the second group other types of piping material are used. The differences in standard mortality ratios for seven cancer sites among three potential asbestos exposure groups based on AC pipe usage was tested using an analysis of covariance. Twelve variables representing nonexposure-related influences on disease rates were combined in four independent factors and used as covariates in these analyses. To the level of sensitivity imposed by the limitations of the study no evidence was found for an association between the use of AC pipe for carrying drinking water and deaths due to gastrointestinal and related cancers in Escambia County, Florida. (Baker-IVI)
W85-02709

**COMPARING EPIDEMIOLOGIC STUDIES OF INGESTED ASBESTOS FOR USE IN RISK ASSESSMENT,**
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
L. S. Erdreich.
Environmental Health Perspectives, Vol. 53, p 99-104, November, 1983. 4 Tab, 16 Ref.

Descriptors: *Risk assessment, *Asbestos, *Drinking water, *Epidemiology, Public health, Cancer, Human diseases, Water quality control, Carcinogens.

Risk assessment studies make use of epidemiologic data in various ways to calculate the dose-response relationship between exposure levels and adverse effects; to establish ranges of exposure known to be safe or unsafe; to verify an endpoint in humans derived from a route or species extrapolation; to support assumptions necessary for performing extrapolation procedures. Cohort studies of inhalation exposure were used to devise the EPA's Ambient Water Quality Criteria (AWQC) for Asbestos. Epidemiological studies of ingested asbestos, all of geographical correlation design, were compared on the basis of their ability to add information in support of both the route extrapolation and low-dose extrapolation used in this risk assessment. (Baker-IVI)
W85-02710

**RELATIONSHIPS OF TOTAL COLIFORM, FECAL COLIFORM, AND ORGANIC POLLUTION LEVELS IN THE TAMAGAWA RIVER,**
Tokyo Univ. of Fisheries (Japan). Dept. of Food Science and Technology.
A. Hiraishi, K. Saheki, and S. Horie.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 6, p 991-997, June, 1984. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Tamagawa River, *Japan, *Bacteria, *Coliforms, Pollution indicators, Water pollution effects, Fecal coliforms, Biochemical oxygen demand.

The Tamagawa River is typical of the watershed system of freshwater rivers in Japan, and has increasingly received inflow of domestic sewage and industrial waste effluents. The population dynamics of total coliform (TCs) and fecal coliform (FCs) in relation to biochemical oxygen demand (BOD) levels in this river system are described. Particular importance is placed on the multiplication of the indicator bacteria in heavily polluted river environments. The levels of the indicator bacteria and BOD markedly increased from the upper streams towards the lower reaches of this river system. There were statistically significant positive correlations among TCs, FCs, and BOD. Also the FC/TC ratios were highly correlated with BOD. The proportion of thermotolerant coliforms and Escherichia coli constituting the TC population increased with increasing BOD levels, whereas the relative concentration of E. coli to the FC population decreased with increasing BOD levels. These results suggest that the population densities of FCs or thermotolerant coliforms in the river environment are directly proportional to the degree of sewage and human waste pollution, which is reflected by BOD levels, but their occurrence in polluted river and estuary waters is due in part to regrowth of some FC members such as Klebsiella pneumoniae. (Baker-IVI)
W85-02717

**METAL-BINDING PROTEINS AND ACTIVITY OF ALKALINE PHOSPHATASE IN THE OYSTER CRASSOSTREA GIGAS IN ANTHROPOGENICALLY POLLUTED ENVIRONMENT (METALLSVYAZYVAYUSHCHIE BELKI I AKTIVOST' SHCHELOCHNOI FOSFATAZY V GIGANTSKOI USTRITSE, OBITAYUSHCHEI V USLOVIYAKH ANTROPOGENNOGO ZAGRYAZNENIYA),**
Akademiya Nauk SSSR, Vladivostok. Inst. Biologii Morya.
Z. S. Evtushenko, N. K. Khristoforova, and O. N. Lukyanova.
Marine Biology (USSR Acad. of Sciences), No. 3, p 66-71, 1984. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Oysters, *Metals, *Enzymes, Zinc, Copper, Cadmium, Proteins.

The nature of the binding of zinc, copper and cadmium with cytoplasmic proteins by the hepatopancreas of the oyster Crassostrea gigas dwelling under conditions of anthropogenic pollution was studied. The proteins were chromatographed on Sephadex G-75. Zinc was bound with high and low-molecular proteins; metallothionein-like proteins were not discovered. A decrease was noted in the activity of alkaline phosphatase in the hepatopancreas and gonads of oyster inhabiting Skrebtsov Island in comparison with the activity of the enzyme from the same organs of oyster dwelling on Popov Island. (Author's abstract)
W85-02719

**EFFECT OF MERCURIC CHLORIDE ON SOME BIOCHEMICAL AND PHYSIOLOGICAL PARAMETERS OF THE FRESHWATER MURREL, CHANNA PUNCTATUS,**
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. V. Sastry, and D. R. Rao.
Environmental Research, Vol. 34, p 343-350, 1984. 4 Tab, 42 Ref.

Descriptors: *Mercuric chloride, *Toxicity, *Water pollution effects, *Murrel, Mercury compounds, Enzymes, Heavy metals, Fish.

The freshwater murrel, Channa punctatus, was exposed to a sublethal concentration of mercuric chloride at 3 micro g/liter of water for 120 days. An insignificant decrease was noted in the body weight of control as well as mercuric chloride-exposed fish afer 120 days. Blood glucose and lactic acid levels fell significantly in mercury-exposed fish. No marked change was noted in glycogen content of liver and muscles. The concentration of lactic acid in liver was unaltered but in muscles the lactic acid level decreased significantly. There was a significant decrease in the rate of absorption of glucose by the intestine of fish exposed to mercury in comparison to control fish. Of the different enzymes examined, G-6-Pase activity was decreased in all five tissues examined. Hexokinase activity in all six tissues of mercury-exposed fish was lower than in control fish, but the decrease was significant only in intestine, kidney, and liver. Dehydrogenases LDH, PDH, SDH, and MDH were decreased significantly in all the tissues examined except LDH in brain and MDH in kidney where an insignificant decrease and an insignificant increase, respectively, were recorded. GDH activity increased in all tissues except gills where a significant decrease was noted. AO activity showed a significant decrease in gills and muscles but in the remaining tissues the enzyme activity increased. An increase in XO activity was noted in brain, gills, and kidney, but no marked alteration was recorded in other tissues. (Baker-IVI)
W85-02727

**EFFECTS OF DICHLOBENIL AND ATRAZINE TO THE POPULATION DENSITY OF ZOOPLANKTON IN AN AQUATIC OUTDOOR SYSTEM (WIRKUNG VON DICHLOBENIL UND ATRAZIN AUF DIE POPULATIONSDICHTE VON ZOOPLANKTERN IN EINEM AQUATISCHEN FREILANDSYSTEM),**
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
L. Peichl, J. P. Lay, and F. Korte.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 4, p 134-145, August, 1984. 12 Fig, 11 Tab, 12 Ref.

Descriptors: *Zooplankton, *Population dynamics, *Water pollution effects, *Herbicides, Atrazine, Dichlobenil, Organic compounds, Agricultural chemicals.

A long term outdoor study was made in compartments of an experimental pond concerning the effects of two herbicides, atrazine and dichlobenil, on the population density of selected zooplankters including rotifers, crustaceans, and insect larvae. The experiment consisted of a three week preapplication period and a nineteen week postapplication period. The chemically induced effects were statistically evaluated compared to controls. The maximum concentrations of atrazine and dichlobenil detected in the water were 200 micrograms and 4.3 mg per liter. Most of the taxa investigated showed significant changes in their population densities following chemical treatment which can be better referred to as secondary effects because of their late occurrence. A direct correlation of these findings to toxicity data from short term lab tests could not be found. (Author's abstract)
W85-02739

**ARYLSULPHATASE ACTIVITY IN POLLUTED LAKE SEDIMENTS,**
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu, and Y. K. Soon.
Environmental Pollution (Series B) Vol. 8, No. 2, p 143-153, 1984. 3 Fig, 2 Tab, 33 Ref.

Descriptors: *Lake sediments, *Water pollution effects, *Enzymes, *Arylsulfatase, Sulfur, Organic matter, Sediments, Lakes, Great Lakes.

Arylsulfatase activities have been determined in a wide variety of lake sediments to see whether they provide any clues on past changes in lake acidity or sediment quality. The variation in arylsulfatase activity with depth of sediments is depicted for the Great Lakes and for the soft-water lakes of northern Ontario. In general, the activity decreased rapidly with depth in the top 10 cm. The arylsulfatase activity was also determined in five agricultural soils from southern Ontario. In these soils, the activities ranged from 0.56 to 0.71 micromol of substrate released per gram of soil per hour and are very similar to those of the surface sediment of the Great Lakes and Turkey Lake. The variations in arylsulfatase activity did not parallel those of organic carbon in the sediment, with the possible exception of Lake Ontario sediments. No apparent relationship between the sulfur content and the enzyme activity could be demonstrated. (Baker-IVI)
W85-02745

**CADMIUM TOXICITY AND ACCUMULATION BY TETRAHYMENA PYRIFORMIS IN CONTAMINATED RIVER WATERS,**
Liege Univ. (Belgium). Dept. of Botany.
F. Berhin, C. Houba, and J. Remacle.
Environmental Pollution (Series A), Vol. 35, No. 4, p 315-329, 1984. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Cadmium, *Toxicity, *Rivers, *Heavy metals, *Tetrahymena, Metals, Water pollution effects, Protozoa, Carbon, Dissolved solids.

Two methods were used to study the responses of Tetrahymena pyriformis to cadmium added to river waters. One depends on the ciliate's growth rate, the other is evaluated from the uptake of cadmium by the cell. In the first test, the supply of E. coli as food could change the characteristics of river waters. It is clear that the level of toxicity is controlled particularly by dissolved carbon content. A comparison of the river waters studied using this test would infer that the less toxic river would be the one which is in reality the most polluted of those sampled because of its organic lead and heavy metals concentrations. In the second test, the river water is not modified except by the addition of cadmium and there is no food supply. The level of accumulation is governed by many physico-chemical parameters which depend on the initial cadmium concentration. Moreover, when killed by 500 micro cadmium/liter, T. pyriformis appeared to adsorb cadmium like an inert particle and accumulated more than living cells. These cadmium loaded cells would settle on the bottom of a river and become another source of cadmium contamination. It is therefore difficult to set values that might be used as reference limits for quality control in rivers, especially as river characteristics depend much more on the sampling time than on the sampling site. (Baker-IVI)
W85-02748

**COMPARISON OF GROWTH, POPULATION STRUCTURE, AND FOOD OF THE CREEK CHUB SEMOTILUS ATROMACULATUS IN UNDISTURBED AND SURFACE-MINING-DISTURBED STREAMS IN TENNESSEE,**
Science Applications, Inc., Oak Ridge, TN.
D. M. Stair, V. R. Tolbert, and G. L. Vaughan.
Environmental Pollution (Series A), Vol. 35, No. 4, p 331-343, 1984. 2 Fig, 1 Tab, 29 Ref. DE contract ET-72-S-05-4946 and Union Carbide Corp. contract W-7405-eng-26.

Descriptors: *Mining wastes, *Water pollution effects, *Streams, *Chubs, *Tennessee, Population dynamics, Environmental effects, Bioindicators, Fish, Growth, Fish food.

Populations of the creek chub Semotilus atromaculatus were examined to determine the effects of surface mining on growth, population structure and food. The extent of changes in population structure and diet of creek chubs correspond to the extent and duration of mining disturbance and subsequent habitat alterations. These results, coupled with examination of water-quality changes over time following the termination of mining activity, can be used to determine the long-term effects and time needed for fish populations to recover from mining related disturbances. Once factors that affect fish populations are identified using tolerant species measures can be taken during mining and reclamation processes to minimize both long term and short term impacts to aquatic communities. (Baker-IVI)
W85-02749

**TOXICITY OF FLUCYTHRINATE TO GAMMARUS LACUSTRIS (AMPHIPODA), PTERONARCYS DORSATA (PLECOPTERA) AND BRACHYCENTRUS AMERICANUS (TRICHOPTERA): IMPORTANCE OF EXPOSURE DURATION,**
Environmental Research Lab.-Duluth, MN.
R. L. Anderson, and P. Shubat.
Environmental Pollution (Series A), Vol. 35, No. 4, p 353-365, 1984. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Toxicity, *Invertebrates, *Insecticides, *Flucythrinate, Organic compounds, Pyrethroids, Water pollution effects, Crustacea, Aquatic insects, Pesticide toxicity.

The effect of synthetic pyrethroid flucythrinate on three non-target aquatic invertebrates was evaluated using continual and short-time exposure methods. Both methods show toxic action at measured concentrations of less than 0.100 micro g/liter. The use of both approaches pointed toward the importance of exposure time in hazard assessment. The results of the continuous exposure experiments showed that Grammarus, Pteronarcys and Brachycentrus are sensitive to low concentrations of the pesticide and that each species responded differently to the length of exposure and exposure concentration. All animals were quickly immobilized at concentrations which ultimately resulted in death for many of the continually exposed, immobilized animals. The Gammarus were the most sensitive followed by Pteronarcys and Brachycentrus. In all cases of continuous exposure, the LC50 decreased with increased exposure time. Exposures for a short time followed by an extended observation period in insecticide free water show that a lethal exposure can occur in less time than estimated from continually exposed animals. (Baker-IVI)
W85-02750

**ACUTE TOXICITY OF SELECTED SUBSTITUTED PHENOLS, BENZENES AND BENZOIC ACID ESTERS TO FATHEAD MINNOWS PIMEPHALES PROMELAS,**
Environmental Research Lab.-Duluth, MN.
G. W. Holcombe, G. L. Phipps, M. L. Knuth, and T. Felhaber.
Environmental Pollution (Series A), Vol. 35, No. 4, p 367-381, 1984. 4 Tab, 17 Ref.

Descriptors: *Water pollution effects, *Fish, *Phenols, *Benzenes, *Benzoic acid esters, *Toxicity, Organic compounds, Fathead minnows, Trout, Catfish, Snails.

Flow-through acute toxicity tests were conducted with 24 organic compounds using fathead minnows Pimephales promelas as test organisms. The tested toxicants consisted of 11 substituted phenols, four substituted benzenes and nine esters. Ethyl salicylate and phenyl salicylate concentrations of 25.9 and 3.44 mg/liter respectively, killed less than 50% of the exposed snails, and the LC50 values for these compounds are greater than the highest exposure concentrations used. Fish sensitivity differences were small for the two substituted phenols, one substituted benzene and the three esters tested with more than one species. Rainbow trout were slightly more than twice as sensitive to 2,3,4,5-tetrachlorophenol than fathead minnows. Channel catfish were about 1.1 times less sensitive than fathead minnows to 2-ethoxyethylacetate, phenyl salicylate and 1,4-dinitrobenzene. Catfish were about 1.3 and 2.7 times more sensitive than fathead minnows to ethyl salicylate and 4-nitrophenol, respectively. In all snail tests the snails were less sensitive than either fathead minnows or channel catfish. Nonylphenol and methyl-4-chloro-2-nitrobenzoate produced hemorrhaged areas in fathead minnows, and methyl-4-chloro-2-nitrobenzoate, 2-allylphenol, 4-t-butylphenol, 4-t-pentylphenol and naphthalene caused slight to severe cases of snail deformities. Some loss of equilibrium was noted in fathead minnows exposed to toxicant concentrations below the 96 hr LC50 values with 4-phenylazophenol, 4-choro-3-methylphenol, nonylphenol, nitrobenzene, 1-chloro-3-nitrobenzene, naphthalene, methyl-4-chlorobenzoate, methyl-4-chloro-2-nitrobenzoate and methyl-2,5-dichlorobenzoate. (Baker-IVI)
W85-02751

**POLLUTION INDICATOR SPECIES OF MACROBENTHOS IN A COASTAL LAGOON,**
Rutgers - The State Univ., Piscataway, NJ. Dept. of Biological Sciences.
R. E. Grizzle.
Marine Ecology - Progress Series, Vol. 18, No. 3, p 191-200, 1984. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Indicator species, *Lagoons, *Sykes Creeks, *Banana River, *Florida, *Macrobenthos, Bioindicators, Species composition, Dissolved oxygen, Water temperature, Water pollution effects, Wastewater pollution.

Life history differences and effects of physicochemical changes on macrobenthos of coastal lagoons were studied for 2 yr at one site in the sewage-polluted, moderately enriched Sykes Creek and a comparison site in the less-polluted Banana River, Florida, USA. Monthly and bi-monthly quantitative sediment samples for faunal analyses were taken from the natural substratum, and recolonization of defaunated sediments set out at 4 different times in 1 yr was monitored concurrently. The top 4 numerical dominants in natural substratum samples from Sykes Creek, i.e. the indicator species, were: Corophium ellisi, Haploscoloplos foliosus, Capitella capitata, Anomalocardia auberiana. Based on recolonization experiments all 4 were identified as opportunistic. However, the top 2 numerical dominants in the Creek (C. ellisi, H. foliosus) also relied on their abilities to exploit food and/or space. Banana River benthos contained a greater relative abundance of equilibrium species and fewer opportunistic species compared to Sykes Creek, suggesting that there has been a shift toward a life history strategy of opportunism in the enriched area. With a lag shift of 2 mo, dissolved oxygen and temperature from the Creek were strongly correlated with macrobenthic density. Also, drastic declines involving most species present were observed in early summer in 1978 and 1979 coinciding (no 2-mo lag) with oxygen/temperature extremes of < 2.5 mg/L and 29 C. These data suggest that the pollution indicator species were as intolerant of oxygen/temperature extremes as non-indicator species. Thus, the numerical dominance of the indicator species in shallow water and sand sediments in Sykes Creek can likely be explained by some combination of superior abilities related to quick invasion and exploitation of food and/or space, competitive interactions could be important. Further concurrent testing of hypotheses is needed. Investigation of the indicator concept was posed as one of the best ways to determine the effects of organic pollution on benthos. (Author's abstract)
W85-02757

**ACCUMULATION AND TOXICITY OF CD, ZN, AG, AND HG IN FOUR MARINE PHYTOPLANKTERS,**
International Lab. of Marine Radioactivity, Monte Carlo (Monaco). Oceanographic Museum.
N. S. Fisher, M. Bohe, and J.-L. Teyssie.
Marine Ecology - Progress Series, Vol. 18, No. 3, p 201-213, 1984. 9 Fig, 6 Tab, 48 Ref.

Descriptors: *Cadmium, *Zinc, *Silver, *Mercury, *Bioaccumulation, *Toxicity, *Trace metals, Diatoms, Chlorophyta, Coccolithophora, Cyanophyta, Adsorption, Water pollution effects, Path of pollutants.

Accumulation and toxicity of Cd, Zn, Ag, and Hg were measured in the diatom Thalassiosira pseudonana, the chlorophyte Dunaliella tertiolecta, the coccolithophore Emiliania huxleyi, and the cyanophyte Oscillatoria woronichinii. Bioaccumulation of the metals was measured over a wide (up to 10 to the 5th power) range of metal concentrations, using gamma-emitting radioisotopes of each metal. Metal content of cells was related to total external metal concentration in all cases, in accordance with Freundlich adsorption isotherms. Dead cells accumulated metals comparably to living cells, indicating that the initial association of metal with the cell is governed by adsorption. Volume/volume concentration factors computed at equilibrium ranged from 300 for Cd in T. pseudonana to 95,000 for Hg in E. huxleyi. Metal toxicity, as measured by depression of cell division rate, could generally be described as an exponential function of the log of the external (or cellular) metal concentration, consistent with the concept of cell thresholds of safe metal accommodation. Regression analyses of the data were used to calculate EC sub 50 and EC sub 0 metal concentrations for each alga/metal combination. The general order of accumulation and metal toxicity vs. external metal concentration was Hg > Ag > Zn > or = Cd. Expressed on a cellular metal basis, Hg was usually

the most toxic, but there was no clear trend for the other metals for all species. Upon normalizing cellular metal data on the basis of cellular weight, volume, and surface area, interspecific comparisons revealed that these algal species can have markedly different surface affinities for metals and that cellular EC50 values ranged from 0.000079 M for Hg in O. woronichinii cells to 0.2 M for Zn in D. tertiolecta cells. The most resistant species to Zn, Ag and Hg was D. tertiolecta. Enhanced metal tolerance in D. tertiolecta was partly attributable to metal exclusion, however these cells were able to tolerate cellular metal concentrations of up to 10 (Zn) or 100 (Ag and Hg) times those in other species. Since the toxicity of any metal was correlated with its concentration factor in a given cell, these data may provide a basis for predicting the toxicity of other metals to algae from metal concentration factors in the cells. (Author's abstract)
W85-02758

**USE OF POLYCHAETE FEEDING GUILDS AS BIOLOGICAL VARIABLES,**
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
D. M. Dauer.
Marine Pollution Bulletin, Vol. 15, No. 8, p 301-305, August, 1984. 2 Fig, 2 Tab, 21 Ref. A.C.O.E. contract DACW 65-81-R-0009.

Descriptors: *Polychaetes, *Feeding guilds, *Ecological distribution, *Chesapeake Bay, Ecological effects, Annelids, Macrobenthos, Estuarine environment.

Macrofaunal components of the marine benthic community are often quantified to indicate environmental health; the use of guilds as the primary biological variables is a new approach to data reduction. Feeding guilds presumably form functional groups that have predictable environmental distributions with utility in predicting or identifying impacts. Densities of polychaete species from three studies in the lower Chesapeake Bay were classified into feeding guilds and correlated with water depth, median phi size and percent silt-clay of the sediment. Polychaete densities were also grouped randomly and correlated with environmental variables. For two of the three studies a feeding guild classification did not give significantly more correlations than expected from random groupings. The present polychaete feeding guilds are too broad in definition to be useful for estuarine systems; many polychaete families contain more than one guild and deciding which guild to use for a particular species may be arbitrary. (Collier-IVI)
W85-02763

**OXYGEN DEMAND AND LONG TERM CHANGES OF PROFUNDAL ZOOBENTHOS,**
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
P. M. Jonasson.
Hydrobiologia, Vol. 115, p 121-126, August, 1984. 5 Fig, 11 Ref.

Descriptors: *Benthos, *Oxygen demand, *Ecological effects, *Lake Esrom, *Denmark, *Dissolved oxygen, Midges, Oligochaetes, Annelids, Sulfur, Metabolism.

Uptake of oxygen by the zoobenthos of Lake Esrom, Denmark, was investigated using data from 1953 to 1973 in an effort to determine the effect of the declining oxygen content in the hypolimnion and its effect upon the dynamics and composition of the profundal zoobenthos. The profundal zoobenthos consists mostly of monocultures of Chironomus anthracinus, Potamothrix hammoniensis, Chaoborus flovicans, and Procladius pectinatus and also consists of Pisidium casertanum, Pisidium subtruncatum and Pisidium henslowanum. Between 1930 and 1970, the oxygen depletion period increased from 1 week to 3 months. The Psidia are seriously affected by the oxygen decline because their respiration declines rapidly at two critical limits, 30 and 15% air saturation. Their numbers declined in 1971-73 to one tenth of the numbers recorded in 1955-57. C. anthracinus had no decline in respiration from 100 to 24% air saturation; a decline occurred between 24 and 2.5% air saturation. This species is extremely well adapted to low oxygen tensions, which was shown by its importance in the profundal community. Potamothrix hammonienis survives the oxygen free conditions better than C. anthracinusdue possibly due to the lower metabolism of the former species and the fact that oligochaetes lower their respiration rate in mixed populations. Another reason might be a different sulfer metabolism between oligochaetes and chironomids. (Collier-IVI)
W85-02770

**OLIGOCHAETE COMMUNITIES AS BIOLOGICAL DESCRIPTORS OF POLLUTION IN THE FINE SEDIMENTS OF RIVERS,**
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Lyon (France). Lab. d'Hydrobiologie.
M. Lafont.
Hydrobiologia, Vol. 115, p 127-129, August, 1984. 2 Tab, 14 Ref.

Descriptors: *France, *Ecological distribution, *Sediments, *Oligochaetes, Bioindicators, Water quality, Water pollution effects, Annelids.

Oligochaeta communities are useful as descriptors of pollution in the fine sediments of large rivers. Forty sampling sites situated in rivers of the East of France were studied to determine the relationship between water quality and Oligochaeta species distribution. Of the most abundant species in the polluted fine sediments, six species are known to be pollution tolerant and five are not known to be (in large rivers). Consequently, the number of resistant Oligochaeta is probably much greater than generally believed. Two indices of biological quality of fine bottoms - pollution impact and a biological parameter - were defined and used for an empirical classification of polluted fine sediments. (Collier-IVI)
W85-02771

**LETHAL AND SUBLETHAL TOLERANCES OF AQUATIC OLIGOCHAETES WITH REFERENCE TO THEIR USE AS A BIOTIC INDEX OF POLLUTION,**
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman, and R. O. Brinkhurst.
Hydrobiologia, Vol. 115, p 139-144, August, 1984. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Oligochaetes, *Bioindicators, *Ecological effects, Water pollution effects, Pollution index, Toxicity.

A series of recent studies have been completed by the authors involving: 1) determining the lethal tolerances of 12 oligochaete species classified (from ecological studies) as tolerant, moderately tolerant and intolerant to selected chemical toxicants and environmental factors under defined bioassay conditions with and without sediment; 2) determining lethal tolerances of candidate species to toxicants in combination with a range of abiotic factors; 3) measuring respiratory stress imposed by exposure to individual and combined sublethal concentrations of toxicants and environmental factors; and, 4) determining differences in lethal tolerance and respiratory stress between individual and mixed species. Surprisingly few previous studies have been done in this area considering the importance of oligochaetes as field pollution indicators. The results of the above major studies coupled with histopathological work are reviewed. Data from these studies substantiate the present use of oligochaete species assemblages as indicators of organic pollution and suggest their use in the laboratory for toxicant screening tests. The range of responses of different oligochaete species to individual and combined stress is complex, particularly in mixed species, which provides useful indications of specific stress factors. The application of these experimental laboratory studies to field situations is described. (Author's abstract)
W85-02773

**COMPARISON OF DIFFERENT METHODS OF WATER QUALITY EVALUATION BY MEANS OF OLIGOCHAETES,**
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
T. D. Slepukhina.
Hydrobiologia, Vol. 115, p 183-186, August, 1984. 2 Tab, 18 Ref.

Descriptors: *Lake Ladoga, *Russia, *River Sukhona, *North Caucasus, *Oligochaetes, *Bioindicators, *Water quality, Lakes, Population density, Species diversity, Tubificids, Aquatic animals, Water pollution effects.

The oligochaetes are the group of invertabrates most often enlisted for bioindication purposes, because their mass development is enhanced in places of strong organic contamination. In Lake Ladoga, on some stations subjected to human influence, accumulation of oligochaetes, particularly Tubifix tubifix, Limnodrilus hoffmeisteri, or Potamothrix hammoniensis, at total population densities of 4,000 ind./sq m has been observed. In the River Sukhona the density of Limnodrilus udekemianus and T. tubifex exceeds 5,000 ind./sq m, reaching a maximum of 22,000 and a biomass of 475 g/sq m. L. hoffmeisteri was present in smaller amounts. In the most contaminated pools of 147 pools studied in North Caucasus, near the inflow of runoff from farms, the number of oligochaetes fluctuated on average between 6,000 and 8,000/sq m, with a maximum value of 31,800. Only the following species were present: L. hoffmeisteri, Limnodrilus helveticus, T. tubifex, P. hammoniensis and Psammoryctides albicola. There is no unique universal method of pollution bioindication. In water bodies of all types the mass development of oligochaetes and the reduction of their species diversity are indications of: (1) large quantities of organic matter; (2) favorable oxygen regime; (3) absence or insignificant quantities of heavy metal solids, petroleum substances and agricultural chemicals; (4) intensive self-purification of the water body by the ingestion of sediment by the oligochaetes. (Collier-IVI)
W85-02775

**TOXICITY OF THE HERBICIDES ENDOTHALL AND DIQUAT TO BENTHIC CRUSTACEA,**
Hamilton Coll., Clinton, NY. Dept. of Biology.
E. H. Williams, E. L. Mather, and S. M. Carter.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 418-422, October, 1984. 1 Fig, 20 Ref.

Descriptors: *Herbicides, *Toxicity, *Benthic environment, *Crustacea, Endothall, Diquat, Water pollution effects, Aquatic weed control.

Endothall and diquat are herbicides commonly applied in lakes to control macrophytes. Endothall and diquat were tested with a flow-through protocol designed to approximate field conditions to determine possible toxicity to benthic crustacea. The highest mortality observed for both Hyalella azteca and Asellus communis was 10% at 120 hr. Dipotassium endothall has a negligible effect on the representative benthic macroinvertebrates. Once applied, endothall normally disappears from the water after 10 to 12 days, with slow initial degradation followed by rapid breakdown. The small effects of endothall seem to be restricted to the dipotassium and disodium salts. Mortality in diquat differs significantly from that in endothall. Results are in agreement with earlier studies that indicated crustacea to be highly susceptible to diquat. (Baker-IVI)
W85-02778

**EFFECTS OF REDUCED PH ON THREE LIFE STAGES OF SUNAPEE CHAR SALVELINUS ALPINUS,**
Maine Univ. at Orono. Dept. of Zoology.
C. H. Jagoe, T. A. Haines, and F. W. Kircheis.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 430-438, October, 1984. 4 Tab, 27 Ref.

Descriptors: *Acidity, *Water quality, *Toxicity, *Char, Water pollution effects, Hydrogen ion concentration, Growth stages, Mortality, Fish eggs.

Four experimental pH levels were tested: 4, 4.5, 5, and 5.5. Sac fry exposed to pH 4 water rapidly became hyperactive. One fry died within 1 hr and more than half were dead after a 17 hr exposure. At pH 4.5 mortalities were first noted after 117 hr of exposure. No mortality was noted at pH 5 or 5.5. Egg mortality was noted during the first 10 hr to not be related to hydrogen ion concentration. Calculated LC50s for exposures of 96 and 192 hr and for an indefinite period differed among life stages. There was little difference among the replicates for a given stage. Yearlings were the most resistant of the three groups to acid stress, and eggs the most sensitive. (Baker-IVI)
W85-02780

**INFLUENCE OF ANIONIC SURFACE-ACTIVE AGENTS ON THE UPTAKE OF HEAVY METALS BY WATER HYACINTH (EICHHORNIA CRASSIPES),**
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Muramoto, and Y. Oki.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 444-450, October, 1984. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Detergents, *Water pollution effects, *Heavy metals, *Water hyacinths, Lakes, Ponds, Industrial wastes, Nutrients, Aquatic plants, Cadmium, Nickel.

Fifteen groups of water hyacinths were prepared. Six were kept in cadmium or nickel alone at concentrations of 1.0, 4.0, 8.0 ppm of cadmium or nickel. Six groups were kept with each metal plus 25 ppm of sodium dodecyl sulfate. One group contained metal mixed anionic detergents, Cd 1.0 ppm + Ni 1.0 ppm + SDS 25 ppm. One group contained SDS 25 ppm alone and there was one control group. No effects of SDS on the increasing ratio of root length were indicated within 25 ppm SDS in water, but significant decreases were observed for concentrations of SDS above 30 ppm. In both Cd and Ni metal alone groups, the weight of whole plants was decreased with an increase in the concentration of metals in water compared with those at the beginning of the experiments. In the Cd plus SDS, and Ni plus SDS group, no particular effects on the plant growth were noted. The uptake of cadmium in plants was higher in root than those in metal plus SDS group. The presence of SDS decreased Cd concentrations in plants at various concentrations of cadmium. The absorption of nickel by water hyacinth was slightly lower compared with that of cadmium. Addition of SDS to nickel containing water did not significantly increase the absorption of nickel. (Baker-IVI)
W85-02781

**EFFECTS OF PUGET SOUND SEDIMENTS AND THEIR ELUTRIATES ON THE LIFE CYCLE OF CAPITELLA CAPITATA,**
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman, and R. Fink.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 451-459, October, 1984. 3 Tab, 13 Ref.

Descriptors: *Sediments, *Puget Sound, *Washington, *Water pollution effects, *Polychaetes, Annelids, Toxicity, Marine sediments.

The survival of all life stages, abnormalities, growth rate, and time from trochophore larvae to reproduction was examined for Capitella capitata exposed to sediments from Puget Sound, Washington. Despite high initial mortalities in some samples, C. capitata was able to complete its life cycle in all sediments. The ability to survive and reproduce in contaminated sediments may be partly due to this species' opportunistic nature, which includes the ability to increase populations rapidly despite high larval mortalities. All tested sediments were able to cause death, and affect growth and reproduction. (Baker-IVI)
W85-02782

**DIFFERENTIAL RESPONSE OF MARINE ORGANISMS TO CERTAIN METAL AND AGRICHEMICAL POLLUTANTS,**
Toledo Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W85-02783

**DISTRIBUTION OF FENITROTHION RESIDUES IN BROOK TROUT (SALVELINUS FONTINALIS) AND LAKE TROUT (SALVELINUS NAMAYCUSH) TISSUES FOLLOWING AERIAL APPICATIONS TO LAC STE-ANNE, QUEBEC,**
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
S. B. Holmes, P. D. Kingsbury, G. Mamarbachi, and P. Mathieu.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 4, p 468-475. October, 1984. 2 Tab, 17 Ref.

Descriptors: *Insecticides, *Toxicity, *Water pollution effects, *Trout, *Fenitrothion, *Lac Ste-Anne, *Quebec, Pesticide residues, Lakes, Organic compounds, Bioaccumulation.

The accumulation and partitioning of fenitrothion residues among different tissues and organs in wild trout were followed after an operational application of this insecticide to a lake. Lac Ste-Anne is a 142 ha oligotrophic lake located at an elevation of 366 m in the Chic Choc Mountains of the Gaspe Peninsula, Quebec, Canada. Fenitrothion was applied as an oil formulation at a dosage of 280 g active ingredient/ha in a total volume of 0.84 L/ha. Fenitrothion rapidly dispersed throughout the lake. One hr after treatment, residues in the north basin were concentrated near the surface, but had already penetrated to the bottom in small amounts. A total of 27 lake trout and 12 brook trout were collected for insecticide residue analysis. All post-spray tissue samples contained measurable levels of fenitrothion. Residues in fat, muscle, intestine and ovaries gradually increased to peak levels 4 days after first application of 280.0, 96.8, 96.3, and 48.2 ng/g, respectively. Residues in the liver peaked 16.1 ng/g 2 days after the first application, but were still almost as high 4 days after treatment. The highest level of fenitrothion was 665.0 ng/g in the visceral fat of lake trout. Fenitrothion residues in the muscle of brook trout peaked at 107 ng/g 2 days after application. (Baker-IVI)
W85-02784

**RESPONSES OF PHYTOPLANKTON TO EXPERIMENTAL NUTRIENT ENRICHMENT IN AN AMAZON FLOODPLAIN LAKE,**
California Univ., Santa Barbara. Dept. of Biological Sciences.
F. V. Setaro, and J. M. Melack.
Limnology and Oceanography, Vol. 29, No. 5, p 972-984, September, 1984. 6 Fig, 5 Tab, 24 Ref.
NSF grants DEB78-23642 and DEB81-11398.

Descriptors: *Phytoplankton, *Lake Calado, *Brazil, *Nitrogen, *Phosphorus, *Nutrients, *Algal growth, Water pollution effects, Floodplains, Seasonal variation, Chlorophyll, Primary productivity.

The relative importance to phytoplankton of nitrogen and phosphorus supply in Amazonian floodplain lakes was investigated in Lake Calado using two complementary approaches over the full range of conditions during a year. While fertilization with phosphate consistently caused increases in chlorophyll and particulate carbon and nitrogen concentrations during the period of rising water, enrichments with ammonium or nitrate elicited mixed responses. From late March through mid-April, samples enriched with nitrogen produced more chlorophyll and particulate nitrogen and carbon than the controls but never more than those augmented with phosphorus. In May, controls and samples fertilized with nitrogen were similar, influenced by the considerable ammonium and nitrate in the epilimnion at this time. Although samples fertilized simultaneously with nitrogen and phosphorus produced more algae than controls, their responses relative to phosphorus additions were inconsistent. A major shift in responses to enrichment with N and P occurred between September and October. In September both N and P stimulated algal growth. In early October, ammonium clearly enhanced algal productivity and abundance, and phosphate enrichment was ineffective. During a period with relatively high nitrate and ammonium concentrations in late October, enrichment with N or P effected no increase in algal biomass. Response to N or P enrichment appears to be different during high and low water in Lake Calado. (Baker-IVI)
W85-02785

**PHOTOSYNTHESIS OF SUBMERSED MACROPHYTES IN ACIDIFIED LAKES. I. CARBON FLUXES AND RECYCLING OF CO2 IN JUNCUS BULBOSUS L.,**
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W85-02794

**EFFECT OF PESTICIDES ON PHOTOSYNTHESIS AND RESPIRATION OF MARINE MACROPHYTES,**
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
S. Ramachandran, N. Rajendran, R. Nandakumar, and V. K. Venugopalan.
Aquatic Botany, Vol. 19, No. 3-4, p 395-399, September, 1984. 2 Tab, 18 Ref.

Descriptors: *Pesticides, *Water pollution effects, *Macrophytes, Phytotoxicity, Organic compounds, Sevin, DDT, Lindane, Dimethoate, Methyl parathion, Endosulfan, Agricultural chemicals, Marine plants.

The effects of a low concentration (50 ppb) of six commonly used pesticides, p,p'-DDT, endosulfan, lindane, methyl parathion, dimethoate, and sevin, on the net photosynthesis and dark respiration activities of six prominent marine macrophytes were examined. Macrophytes showed differential responses in their activities to different pesticides. Organochlorine pesticides inhibited photosynthesis and respiration to a greater extent than organophosphorus and carbamate compounds. Among the organochlorine pesticides, DDT reduced photosynthesis significantly in three of the six macrophytes studied. Endosulfan was apparently less toxic at this concentration to all six macrophytes. Lindane reduced photosynthesis and respiration in E. intestinalis to levels below 50% and photosynthesis in Halodule univervis to levels below 70%. Dimethoate and methyl parathion affected the halophytes H. uninervis more than the other macrophytes. The carbamate pesticide sevin exerted no significant effect on photosynthesis, but increased respiration in four of the six macrophytes. The pesticides DDT and lindane exerted a more toxic effect to the macrophytes than the other pesticides. These pesticides are persistent and can cause acute toxicity. (Baker-IVI)
W85-02795

**INFLUENCE OF LOW CONCENTRATIONS OF CADMIUM, COPPER AND ZINC ON PHYTOPLANKTON OF NATURAL WATER SAMPLES,**
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
K. Wolter, U. Rabsch, P. Krischker, and A. G. Davies.
Marine Ecology, Progress Series, Vol. 19, No. 1 and 2, p 167-173, August, 1984. 7 Fig, 18 Ref.

Descriptors: *Heavy metals, *Phytoplankton, *Water pollution effects, Cadmium, Copper, Zinc.

Water samples from different areas were investigated after addition of varying concentrations of heavy metals, zinc, cadmium, and copper. Accumulation of metals by phytoplankton was measured, using the radioisotopes Cd-109, Zn-65, and Cu-64. The influence of metal on the carbon fixation rate of phytoplankton and on glucose incorporation by bacteria was determined. Metal accumulation by the phytoplankton examined was higher at low Cd concentrations and the enrichment

factor (EF) values are related to biovolume concentration in water. In most cases, accumulation was accompanied by a measureable loss in phytoplankton activity. No saturation was reached at concentrations up to 50 micro g/l. EF values were higher at concentrations below 10 micro g/l. This was due to the metabolism of the organisms tested. Cells were affected at higher Cd concentrations so that their activity decreased and active accumulation of Cd stopped. Further uptake of Cd at higher concentrations was due to passive accumulation. Corresponding data of metal content per chlorophyll a unit for the point when accumulation changes are compared for different samples. (Baker-IVI)
W85-02803

**SUSCEPTIBILITY OF ENVIRONMENTALLY IMPORTANT HETEROCYCLES TO CHEMICAL DISINFECTION: REACTIONS WITH AQUEOUS CHLORINE, CHLORINE DIOXIDE, AND CHLORAMINE,**
Minnesota Univ.-Duluth. Dept. of Chemistry.
S. Lin, and R. M. Carlson.
Environmental Science and Technology, Vol. 18, No. 10, p 743-748, October, 1984. 7 Fig, 2 Tab, 61 Ref. EPA grants R807455 and R809695.

Descriptors: *Disinfection, *Chloramines, *Chlorine dioxide, *Chlorine, *Water pollution effects, Water pollution sources, Chemical reactions, Chlorination, Water treatment, Disinfection.

Eighteen environmentally significant heterocycles were subjected to dilute aqueous solutions of chlorine, chlorine dioxide, and chloramine to examine those chemical transformations anticipated during water renovation. Reactions with hypochlorous acid/hypochlorite generate products that incorporate chlorine as well as introduced oxygen into the molecule. Chlorine dioxide gave predominantly oxygenation products. The reactions involving chloramines proceed at such a very slow rate relative to chlorine dioxide or hypochlorous acid/hypochlorite that significant amounts of reaction products from hetero-PAH should not be observed during normal water disinfection processes. Where the pH may be lowered to about 5, a significant increase in product formation should be anticipated. An aqueous reaction medium has a significant impact on the nature of the products. For example, dimerization products often seen in the oxidation of indole, 2-phenylindole, and N-phenylpyrrole in organic solvents were not detected in this study. Some of the products of chemical disinfection of hetero-PAH have adverse biological activity. This observation may offset the positive effect of eliminating some of the hetero-PAH which themselves are reported to possess possible mutagenic properties. (Baker-IVI)
W85-02804

**SUBSTRATE-MEDIATED RESPONSE OF STREAM INVERTEBRATES TO DISTURBANCE,**
Georgia Univ., Athens. Dept. of Entomology.
M. E. Gurtz, and J. B. Wallace.
Ecology, Vol. 65, No. 5, p 1556-1569, October, 1984. 6 Fig, 4 Tab, 69 Ref.

Descriptors: *Invertebrates, *Streams, *Clear-cutting, *Appalachian Mountains, Forest management, Logging, Moss, Stability, Land use, Management.

The response of aquatic invertebrates to a major watershed disturbance, clear-cutting, was examined in a second-order stream in the southern Appalachian Mountains. For 21 months after the start of logging, invertebrates were sampled in four substrate types: rock face, cobble riffles, pebble riffles, and sand. Clear-cutting of a watershed is a large-scale, low-frequency, anthropogenic disturbance that has no precise natural analog with respect to its effects on a stream ecosystem. The response of invertebrates to such disturbances is mediated by substrate, which suggests that substrate should be an important consideration in the design and interpretation of ecological studies of streams. In the stream that drained the clear-cut watershed more taxa increased in density in moss-covered rock face than in any other substrate. Cobble riffles were next, followed by pebble riffles and sand. Conversely, the number of taxa with significant reductions in density was highest for sand substrates, followed by pebble, cobble, and rock face. Predictive models of stream response to disturbance should take into consideration these substrate-associated factors. Logging practices that minimize sediment inputs and streamside canopy alteration could reduce the effects on the invertebrate communities. (Baker-IVI)
W85-02818

**HEAVY METALS AND HIGH PUP MORTALITY IN THE SAIMAA RINGED SEAL POPULATION IN EASTERN FINLAND,**
Joensuu Univ. (Finland). Dept. of Biology.
H. Hyvarinen, and T. Sipila.
Marine Pollution Bulletin, Vol. 15, No. 9, p 335-337, September, 1984. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Seals, *Heavy metals, *Finland, *Lake Saimaa, *Water pollution effects, Nickel, Mercury, Cadmium, Lead, Chromium, Hair.

Hair nickel, mercury, cadmium, lead and chromium concentrations were measured in still-born ringed seal pups and from other ringed seal groups from Lake Saimaa in Finland. Nickel concentration was significantly higher in the hair samples of still-born pups as compared to live-born pups and to adult seals. There was assumed to be some connection between the stillbirth of the pups and nickel concentration of the hair. Mercury concentration of the natal hair of pups was significantly higher than the mercury concentration of the first adult hair, but no clear connection between still birth and mercury pollution was noted. No differences were noted in cadium, lead and chromium concentrations of the hair of still-born and other ringed seal groups. The source of nickel in the Lake Saimaa is still unclear, but there is a considerable amount of industry in the area. It is also noted that the high nickel concentration in the hair of still-born pups may also be a consequence of some metabolic disturbance, which could be the main factor in the background of still-births. (Baker-IVI)
W85-02839

**IN VITRO STUDY OF THE EFFECTS OF ZINC ON OSMOREGULATORY PROCESSES,**
Barcelona Univ. (Spain). Facultat de Biologia.
S. Crespo.
Marine Pollution Bulletin, Vol. 15, No. 9, p 341-342, 1984. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Fish, *Water pollution effects, *Osmoregulatory processes, *Zinc, Heavy metals, Killifish, Toxicity.

In an attempt to relate electrophysiological parameters, short-circuit current, potential difference and transmural resistance to morphological changes caused by zinc to the opercular epithelium of the killifish, the short-circuited opercular epithelium of seawater adapted killifish, Fundulus heteroclitus, was studied following addition of zinc to both serosal and mucosal sides of the preparation. Zn inhibited the short-circuit current which is a direct measure of the chloride transport across the epithelium. Light microscope observations showed that the mucosal side of the epithelium was completely desquamated after 1 hr exposure to Zn. It is suggested that desquamation of gill epithelia described by several authors following in vivo Zn contamination is a direct consequence of the breakdown of osmoregulatory processes. (Baker-IVI)
W85-02840

**MORPHOMETRIC FEATURES OF THE ROACH, RUTILUS RUTILUS, OF IVAN'KOVSKOYE RESERVOIR IN THE ZONE AFFECTED BY WARM WASTE WATERS,**
Vserossiiskii Nauchno-Issledovatel'skii Inst. Prudovogo Rybnogo Khozyaistva, Konakovo (USSR). Upper Volga Dept.
V. V. Filon.
Journal of Ichthyology, Vol. 20, No. 3, p 50-57, 1980. 4 Tab, 19 Ref. Translated from Voprossy Ikhtiologii, Vol. 20, No. 3, 1980.

Descriptors: *Fish, *Reservoirs, *Thermal pollution, *Powerplants, Thermal water, Water pollution effects.

A morphometric description is given of the adult roach, Rutilus rutilus, which inhabits areas of different thermal regimes in the reservoir. These regimes include the zone influenced by the warm waste waters of the regional power station and the zone with normal reservoir conditions. Warm waters have a positive influence on the external indices of the roach. The improvement in feeding conditions was conducive to an increase in body depth and predorsal distance and to a decrease in snout length. In the roach, meristic characters have not changed appreciably. Differences in the fin size of roach underyearlings from these sections, accounted for by their existence under conditions of different flow velocity, are retained in adult fish. In Kremenchug Reservoir conditions of existence of the roach are more favorable than in Ivan'kovskoye Reservoir. A comparison of the Kremenchug roach with the roach from the zone of heated waters produced fewer differing characters than a comparison between the Kremenchug roach and the roach from the control section of Ivan'koyskoye Reservoir. The number of elements in the meristic characters of the roach from Ivan'kovskoye Reservoir is greater than in the more southerly bodies of water; this corresponds to the general pattern of geographic variability in meristic characters. (Baker-IVI)
W85-02846

**TOXIC EFFECT OF MERCURY ON SALMON LARVAL, ONCORHYNCHUS KETA AND O. KISUTCH,**
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
S. A. Petukhov, and N. G. Storozhuk.
Journal of Ichthyology, Vol. 20, No. 6, p 138-141, 1980. 1 Fig, 3 Tab, 9 Ref. Voprossy Ikhtiologii, Vol. 20, No. 6, 1980.

Descriptors: *Water pollution effects, *Salmon, *Larvae, *Mercury, *Toxicity, Population dynamics, Reproduction, Mortality, Heavy metals.

Chum salmon and coho salmon eggs were obtained at the stage of commencement of organogenesis. Following acclimation for 2 days, eggs were placed in batches of 500 on frames and incubated in 1 l of water at a constant 8 C. Coho eggs were incubated in mercuric chloride solutions for 25 days. An experiment with larvae lasted 140 days. Chum embryos were placed in the same mercuric chloride solutions after hatching and were used in the experiment for 90 days. Mortality of the chum occurred during the first 40 days of exposure; it was 15% in the variant in which the concentration of the toxicant was 1 micro g/l, 13% at 5 micro g/l and 30% at 25 micro g/l, 12% in the control. Mass mortality of coho larvae was noted from beginning to end of hatching and was 12% in the variants in which the concentration of the toxicant was 1 micro g/l, 11% at 5 and 25 micro g/l, and 3% in the control. Consequently, the coho was more tolerant of mercury. An appreciable percentage mortality of larvae of this species was noted at mercury concentrations of 25 micro g/l. It is suggested that when fish develop from the stage of embryogenesis under conditions of an increased content of toxicants of the heavy metal group the most resistant individuals survive. A reduction in the concentration of biologically active metals was noted in salmon larvae reared in an environment with an increased concentration of mercury. (Baker-IVI)
W85-02848

**INFLUENCE OF MERCURY ACCUMULATION ON FISH,**
Kaspiiskii Nauchno-Issledovatel'skii Inst. Rybnogo Kozyaistava, Makhachkala (USSR).
V. K. Dokholyan, A. M. Akhmedov, T. P. Akhmedova, and G. S. Shleyfer.
Journal of Ichthyology, Vol. 21, No. 3, p 103-112, 1981. 6 Fig, 4 Tab, 17 Ref. Translated from Voprossy Ikhtiologii, Vol. 21, No. 3, 1981.

Descriptors: *Water pollution effects, *Fish, *Mercury, *Accumulation, Population dynamics, Fish populations.

Questions of the accumulation and distribution of mercury in the organs and tissues of different species of fish were examined in relation to the influence of mercury on survival, physiological and biochemical indices of the blood and brain. In the sturgeon and the roach, mercury accumulates primarily in the kidneys, liver, spleen and gills. The uneven distribution is evidently due to differentiation and differences in the degree of intensity of the metabolic processes of the cells in the organs and tissues, and the physico-chemical mechanism of the interaction of mercury with the biological structure is also important. There are substantial changes in the composition of the blood as a result of intoxication. In the sturgeon and roach a drop is noted in erythrocytes, hemoglobin and leukocytes and qualitative changes in the red blood cells also occur. Deviations were also noted in the correlation of individual forms of leukocytes. These changes are evidently provoked both by the direct presence of mercury in the blood stream and by its disruption of the functions of the hematopoetic organs. Mecury poisoning leads to disruption of the nitrogen metabolism of the brain of the fish. With the accumulation of mercury in fish to a certain critical level, the metabolic processes are inhibited or altered and the defense functions of the blood are weakened. (Baker-IVI)
W85-02849

**EFFECT OF MERCURY ON THE RESPIRATION RATE OF LARVAL PINK SALMON, ONCORHYNCHUS GORBUSCHA,**
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
N. G. Storozhuk, and B. P. Smirnov.
Journal of Ichthyology, Vol. 22, No. 5, p 168-171, 1982. 2 Fig, 9 Ref. Translated from Voprossy Ikhtiologii, Vol. 22, No. 5, 1982.

Descriptors: *Salmon, *Mercury, *Respiration, *Toxicity, Water pollution effects, Metabolism, Larvae, Fish eggs, Heavy metals.

The eggs of pink salmon were obtained at the beginning of organogenesis. After 2 day acclimatization, 500 eggs were placed in incubation frames in one liter water at 8 C. Eggs were incubated in mercury solution for 300 days and larvae were used experimentally for 150 days. The experiments on the eggs and larvae were carried out with two replications using 300 eggs or larvae for each treatment. The toxicant concentration in the experimental aquaria were 1.0 and 25.0 g Hg/liter. Oxygen consumption by pink salmon larvae in mercury concentrations of 25 micro g/liter was sharply decreased even on the 4th day after hatching, and the oxygen consumption by the experimental fishes was half at the time of changeover to active feeding in comparison to the control. Mercury content in the body of the experimental fishes reached 4.0 micro g/g of fresh weight. Overall findings showed an inhibition of the metabolic processes in young pink salmon when kept in a medium with high mercury content. This can be a result of replacement of copper, iron, and zinc by mercury in the metal containing enzymes. The minimum mercury concentration in pink salmon larvae causing a harmful metabolic effect is 1 micro g/g of live weight which is achieved by maintaining the larvae for 60 days in the medium with the toxicant concentration of 1 micro g/liter. This concentration should be considered harmful for the species. (Baker-IVI)
W85-02853

**EFFECT OF PESTICIDES ON RUSSIAN STURGEON, ACIPENSER GUELDENSTAEDTI (ACIPENSERIDAE), IN THE EMBRYONIC-LARVAL PERIOD,**
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
L. S. Tikhonova, and I. A. Shekhanova.
Journal of Ichthyology, Vol. 22, No. 5, p 172-175, 1982. 1 Fig, 2 Tab, 3 Ref. Translated from Voprosy Ikhtiologii, Vol. 22, No. 5, p 172-175, 1982.

Descriptors: *Water pollution effects, *Sturgeon, *Carbamate pesticides, *Ordram, *Embryonic growth stage, *Larval growth stage, Growth stages, Toxicity, Bioassays, Gastrulation.

Embryos and larvae of Russian sturgeon, Acipenser gueldenstaedti, were used in an assay of the toxicity of the carbamate pesticide, Ordram. Ordram is used widely in rice fields for weed control. The observations on the dynamics of mortality of the sturgeon embryos throughout the period of their development pointed to gastrulation as the most sensitive stage to carbamates, since most of the embryos died in this period. At the age of 130 h, the control embryos reached the developmental stage XXXIV, in which the embryo extracted from the shell was completely straight and slowly moving. The embryos kept in a 5.0 mg/l Ordram solution were at developmental stage XXXII; embryos extracted from the shells were still not fully straight, and the head section was much smaller. Apparently, the process of morphogenesis stops under the action of Ordram ultimately leading to an increase in the duration of incubation of the eggs or the hatching of undeveloped and deformed embryos. The resistance of the sturgeon embryos and larvae against carbamates decreases in the process of development. Considering the low resistance of sturgeon in the embryonic-larval period, it is particularly important to protect the spawning grounds from pollution. The threshold concentration of Ordram during the embryonic-larval period is 0.005 mg/liter, and the minumum lethal concentration is 0.5 mg/liter. (Collier-IVI)
W85-02854

**ACID PRECIPITATION IN THE COLORADO FRONT RANGE: AN OVERVIEW WITH TIME PREDICTIONS FOR SIGNIFICANT EFFECTS,**
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2K.
W85-02856

**INFLUENCE OF WATER TABLE AND ATMOSPHERIC CO2 CONCENTRATION ON THE CARBON BALANCE OF ARCTIC TUNDRA,**
Clemson Univ., SC. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2G.
W85-02857

**BIOCONCENTRATION POTENTIAL OF POLYDIMETHYLSILOXANE (PDMS) FLUIDS BY FISH,**
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
N. Watanabe, T. Nakamura, and E. Watanabe.
Science of the Total Environment, Vol. 38, p 167-172, 1984. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Biological magnification, *Organic compounds, *Fish, *Polydimethylsiloxane, Water pollution effects, Fish populations, Toxicity.

The water solubilities (S), octanol/water partition coefficients (Kow) and bioconcentration factors (BCF) of four commercial grade polydimethylsiloxane (PDMS) fluids covering a wide range of molecular weights were measured. Silver carp were housed in an aquarium whose water was circulated through a PDMS fluid-coated glass bead column for one week prior to the introduction of the fish. Four fish samples were taken for PDMS analysis at hours 0 and 72. Circulation flow rate was maintained at 3.5 ml/min for 72 hr of accumulation study. The results indicate that a previously described correlation between S and Kow for organic chemicals may be invalid for PDMS fluids; an alternative correlation is proposed. Some PDMS fluids tend to have a bioconcentration potential in silver carp. (Baker-IVI)
W85-02865

**SOVIET-AMERICAN COOPERATION IN THE FIELD OF PROTECTING WATER FROM POLLUTION,**
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
For primary bibliographic entry see Field 6E.
W85-02882

**XENOBIOTIC PERTURBATION OF MICROBIAL GROWTH AS MEASURED BY CO2 UPTAKE, IN AQUATIC HETEROTROPHIC BACTERIA,**
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5A.
W85-02885

**CANCER IN WILD FRESHWATER FISH POPULATIONS WITH EMPHASIS ON THE GREAT LAKES,**
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5A.
W85-02886

**BRAIN ACETYLCHOLINESTERASE AND BACKBONE COLLAGEN IN FISH INTOXICATED WITH ORGANOPHOSPHATE PESTICIDES,**
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. I. Kozlovskaya, and F. L. Mayer, Jr.
Journal of Great Lakes Research, Vol. 10, No. 3, p 261-266, 1984. 4 Fig, 3 Tab, 32 Ref.

Descriptors: *Fish, *Water pollution effects, *Pesticide toxicity, *Organophosphates, Phosphates, Toxicity, Acetylcholinesterase, Collagen, Toxicity.

Diminished levels of brain cholinesterase have been observed at all exposures of fish to organophosphate pesticides including acute, sublethal, and intermittent sublethal exposures. Recovery to preexposure levels appears to be slow, although external symptoms of intoxication disappear relatively more quickly. Excluding acute nonspecific stress situations, brain acetylcholinesterase activity can be expected to decrease by 75 to 90% prior to mass mortality of exposed populations. Organophosphate compounds possess accumulative effect. Periodic intermittent exposure to sublethal concentrations over time may produce results similar to acute exposures. In this situation, the death of fish is observed at a total dose which is significantly less than the minimum lethal concentration. Chronic exposure to organophosphate pesticides may alter fish growth without causing mortality. (Baker-IVI)
W85-02888

**AVOIDANCE OF SUBLETHAL DOSES OF COPPER AND ZINC BY TUBIFICID OLIGOCHAETES,**
Toronto Univ. (Ontario). Dept. of Zoology.
M. J. McMurtry.
Journal of Great Lakes Research, Vol. 10, No. 3, p 267-272, 1984. 2 Tab, 27 Ref.

Descriptors: *Benthos, *Heavy metals, *Sediments, *Tubificids, *Oligochaetes, *Toronto Harbor, *Lake Ontario, Water pollution effects, Zinc, Copper, Toxicity, Behavior.

Worms and sediment were collected in February and March of 1981 from Keating Channel in Toronto Harbor, Lake Ontario. Sublethal doses of copper sulfate and zinc sulfate were added singly and together to cores of the sediment populated by Tubifex tubifex and Limnodrilus hoffmeisteri. The result of the experiment demonstrates an avoidance response to sediment containing sublethal concentrations of copper or zinc. There is no evidence that the effects of copper and zinc are additive. The mean number of worms colonizing islands from epicenters treated with copper and zinc is higher than for either copper or zinc treatments, but the difference is not significant. Extrapolation of the result to natural communities is limited by a lack of information on the dispersive capabilities of tubificids. While they can avoid unsuitable conditions in a very small area, the scale of their dispersive capability may not be equal to or greater than the scale of polluted patches in the field. Tubificids can tolerate far higher concentrations of metals in sediment than metals in water. This experiment

offers one way in which avoidance testing can be adapted for sediment dwelling invertebrates. (Baker-IVI)
W85-02889

**EVALUATION OF THE TOXICITY OF SODIUM PENTACHLOROPHENATE, PENTACHLOROPHENOL AND PHENOL TO THE SNAIL VIVIPARUS BENGALENSIS (L.),**
Roorkee Univ. (India). Dept. of Zoology.
P. K. Gupta, and V. S. Durve.
Archiv fur Hydrobiologie, Vol. 101, No. 3, p 469-475, September, 1984. 3 Tab, 24 Ref.

Descriptors: *Phenols, *Snails, *Toxicity, *Sodium pentachlorophenate, *Pentachlorophenol, *Bioassay, Lethal concentration, Water pollution effects, Invertebrates, Molluska.

The freshwater pondsnail Viviparus bengalensis L. were exposed to various concentrations of sodium pentachlorophenate, pentachlorophenol and phenol to evaluate their toxic effects by static bioassay tests. The 96 hr median lethal concentrations (Lc50s) and their 95% confidence limits worked out on the basis of snail mortality percentage were in mg/l 0.720 (0.590-0.878) of NaPCP, 0.840 (0.712-0.991) of PCP and 69.0 (51.11-93.15) of phenol. Their relative potencies suggested that NaPCP was the most toxic and the phenol the least toxic among the three chemicals. (Author's abstract)
W85-02898

**REACTIONS OF CHLORINE DIOXIDE WITH AQUATIC ORGANIC MATERIALS AND THEIR HEALTH EFFECTS,**
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
C. Rav-Acha.
Water Research, Vol. 18, No. 11, p 1329-1341, 1984. 10 Fig, 1 Tab, 92 Ref.

Descriptors: *Disinfectants, *Cholorine dioxide, *Chlorination, *Toxicity *Chemical reactions, Water pollution effects, Trihalomethanes, Humic acids, Fulvic acids, Aldehydes, Carboxylic acids, Quinones.

One of the most promising of alternatives to water chlorination is treatment with chlorine dioxide which does not lead to the formation of trihalomethanes (THM). Chlorine dioxide reacts primarily as a one-electron acceptor, in contrast to chlorine which acts via a variety of electrophilic, oxidative, and radical pathways. Consequently, the reactions of ClO2 are much more selective and specific than those of chlorine. Chlorine seems to be more efficient for the general removal of aquatic organics (TOC); if the primary consideration is to avoid the formation of harmful by-products, then ClO2 may be the disinfectant of choice. One of the major weaknesses of ClO2 is that upon reaction with aquatic organics, abour 50% of it is converted to chlorite. The more desirable water treatment should include physical processes to reduce the organic content prior to disinfection. The principle organic by-products formed by ClO2 in drinking water would probably be quinones and hydroquinones produced by the reaction of ClO2 with aquatic humic and fulvic acids. This is in addition to low molecular weight aldehydes and carboxylic acids. Although most of the aldehydes (with the exception of formaldehyde and alpha-keto-aldehydes) and carboxylic acids are generally considered to be non-toxic, some quinones and hydroquinones have recently been found to possess negative biological activities (Trevors, J.T. and J. Bursuraba, 1980. Bull. Environ. Contam. Toxic., Vol. 25, p 672-675). (Collier-IVI)
W85-02904

**EVALUATION OF THE POTENTIAL TOXICITY OF TREATED BLEACHED KRAFT MILL EFFLUENT TO STRIPED BASS (MORONE SAXATILIS WALBAUM) LARVAE EXPOSED THROUGH METAMORPHOSIS TO THE JUVENILE STAGE,**
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
D. T. Burton, R. J. Klauda, L. W. Hall Jr., and, M. A. Jepson.
Water Research, Vol. 18, No. 11, p 1365-1376, 1984. 5 Fig, 8 Tab, 43 Ref.

Descriptors: *Kraft Mills, *Effluents, *Bass, *Life cycles, *Toxicity, Pulp and paper industry, Bioassay, Biological oxygen demand, Suspended solids, Color, Water pollution effects.

Twenty-day-old striped bass (Morone saxatilis) larvae were exposed to a range of treated bleached kraft mill effluent (BKME) concentrations from 0 to 20% effluent by volume (v/v) under continuous flow test conditions. The experimental test concentrations in the 2-20% BKME test aquaria had a BOD5 which ranged from < 1 to 5 mg/l, TSS 12-17 mg/l and true color 35-416 mg/l. Bleached kraft mill effluent did not kill larvae exposed to it for 20 days through metamorphosis to the juvenile stage. The BKME did not alter growth in length, weight or condition factor in larvae over the 20-day exposure period as determined by multiple regression analysis. A linear regression analysis on the dry weight data at Day 20 only, however, indicated a trend of decreasing weight with increasing BKME concentration. Effluent-exposed larvae also developed normally during the 20-day study. All individuals examined completed the transformation from postlarvae to juveniles by the age of 40 days. (Author's abstract)
W85-02908

**DYNAMICS OF MERCURY AND CADMIUM UPTAKE INTO DIFFERENT ORGANS OF ANODONTA CYGNEA L.,**
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
K. V.-Balogh, and J. Salanki.
Water Research, Vol. 18, No. 11, p 1381-1387, 1984. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Mercury, *Cadmium, *Mussels, *Bioaccumulation, Trace metals, Gills, Kidney, Adductor muscles, Animal physiology, Water pollution effects.

The bioaccumulation of Hg and Cd into various organs of the freshwater mussel Anodonta cygnea was investigated during an 840 h experimental period. Parallel with the metal concentrations the periodicity of activity and the body weight of the animals were also checked. The accumulation of Hg in all of the investigated organs, and that of the Cd into the kidney have two phases: up to 24 h it was non linear; between 24 and 72 h it became linear in most organs up to 840 h, and could be characterized by a regression line. For Hg accumulation the gills were exceptions and for Cd accumulation the kidney and viscera were exceptions; saturation was observed after 504 and 672 h, respectively. The speed of Hg and Cd uptake was different in various organs of Anodonta cygnea. Accumulation into the kidney of Hg was six times faster than of Cd. As compared to the adductor muscles the Hg and Cd uptake of the kidney was 20 and 10 times faster, respectively. The factor of concentration in all organs except adductor muscles was over 1000; in case of the kidney, the rate of bioconcentration for Hg reached nearly 100,000. The dry weight of organs dropped the metal uptake by 20-60%, but no mortality was observed up to 840 h. In the presence of Hg and Cd the filtering activity of the mussels became reduced as a result of increase of inactive rest periods. Nevertheless, the decrease of activity did not prevent the linear uptake of metals into animal. (Author's abstract)
W85-02910

**BACTERIOPLANKTON IN AN URBAN RIVER: THE EFFECTS OF A METAL-BEARING TRIBUTARY,**
Hull Univ. (England). Dept. of Plant Biology.
C. R. Milner, and R. Goulder.
Water Research, Vol. 18, No. 11, p 1395-1399, 1984. 3 Tab, 29 Ref.

Descriptors: *Bacteria, *Trace metals, *Water pollution effects, *River Aire, *West Yorkshire, *England, Copper, Zinc, Lead, Cadmium, Rivers, Path of pollutants.

Concentrations of total Cu, Zn, Pb and Cd in the River Aire, West Yorkshire, were elevated close to the confluence of a metal-bearing tributary but rapidly decreased over 500 m downstream. Heterotrophic activity of bacterioplankton appeared to be inhibited adjacent to the confluence, but concentrations of total bacteria, colony-forming units and chromogenic colony-forming units were not depressed. Bacterial variables were not (negatively) correlated with metals (except heterotrophic activity with Cu) but correlations were found between bacteria and other environmental variables. Hence bacterioplankton was probably controlled by environmental variables other than metals originating from the tributary. (Author's abstract)
W85-02912

**MORPHOLOGICAL CHANGES IN THE GILL OF CARP (CYPRINUS CARPIO L.) EXPOSED TO ACUTELY TOXIC CONCENTRATIONS OF METHYL BROMIDE,**
Agricultural Univ., Wageningen (Netherlands). Dept. of Toxicology.
J. H. L. Segers, J. H. M. Temmink, J. H. L. Van Den Berg, and R. C. C. Wegman.
Water Research, Vol. 18, No. 11, p 1437-1441, 1984. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Carp, *Water pollution effects, *Methyl bromide, *Toxicity, *Gills, Fish physiology, Bromides, Halogenated pesticides, Pesticides.

The acute toxicity of methyl bromide (CH3Br) to carp (Cyprinus carpio L.) was determined in experiments with a 4 h exposure period. The 4 h-LC50 was calculated at approximately 17 mg/l, i.e. the order of magnitude of actually encountered peak concentrations in surface water. The concentration-effect curve was found to be very steep and the response was somewhat delayed. Morphological damage to the gill epithelium, indicative of alkylation of cell membranes, was the most pronounced effect of CH3Br. It consisted of initial swelling of the lymphatic space and vacuolization of the epithelial cells, followed by disintegration of the epithelium and invasion of leukocytes. Death of the fish was probably caused by suffocation. (Author's abstract)
W85-02916

**ACUTE TOXICITY OF CHROME ELECTROPLATING WASTES TO MICROORGANISMS: ADSORPTION OF CHROMATE AND CHROMIUM (VI) ON A MIXTURE OF CLAY AND SAND,**
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, A. A. Nomani, and A. Ahmad.
Water, Air and Soil Pollution, Vol. 23, No. 2, p 119-127, August, 1984. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Chromate, *Chromium, *Adsorption, *Toxicity, *Clay, *Bacteria, *India, Electroplating, Heavy metals, Water pollution effects, Wastewater treatment, Industrial wastewater, Sulfates, Chlorides, Silica, Nitrogen, Phosphorus, Alkalinity, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Conductivity, Calcium carbonate, Osmotic pressure.

The toxicity of chrome electroplating wastes to microorganisms was investigated and an inexpensive method for removal of chromate and chrome (VI) from the effluents was developed. Chrome electroplating wastes were collected from two industrial plants in India. The wastes were found to be rich in sulfate, chloride, silica, N, P, chromate, and Cr(VI). The wastes were alkaline in nature and had low levels of dissolved oxygen and low BOD and COD. In cultures using sucrose substrate as a carbon source (in 300 mL BOD bottles) 0.5 mL of the wastes showed weak toxic effects in repressing the BOD of the system. Pronounced repression of the activity of saprophytic bacteria started with 2 mL of waste and increased with an increasing volume of waste. All microbial activity was retard-

ed with 12 mL of waste. Inhibition of nitrifying bacteria activity was only observed when 15 mL of the waste had been added. Nitrifying bacteria can mildly tolerate effects of wastes as compared to the saprophytic bacteria. Clay-sand mixtures were used as adsorbents for chromate and chromium (VI); mixtures high in clay content were suitable for the removal of Cr from the wastes. The clay was characterized by pH 7.9 to 8.0, electrical conductivity 0.000350 to 0.00040 mhos/cm, osmotic pressure 0.79 to 0.82, calcium carbonate 8.14 to 10.7% and organic matter 0.84 to 0.86%. Its high cation exchange capacity and strong binding force make the clay a good adsorbent for chromate and Cr(VI). The column filled with pure clay adsorbed nearly 95.6 to 96% chromate and 99 to 99.2% Cr(VI). (Collier-IVI)
W85-02921

**TOXICITY AND BINDING OF COPPER, ZINC, AND CADMIUM BY THE BLUE-GREEN ALGA, CHROOCOCCUS PARIS,**
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
A. Les, and R. W. Walker.
Water, Air, and Soil Pollution, Vol. 23, No. 2, p 129-139, August, 1984. 9 Fig, 35 Ref.

Descriptors: *Toxicity, *Binding, *Bioaccumulation, *Copper, *Zinc, *Cadmium, *Cyanophyta, *Chroococcus, *Algae, Trace metals, Adsorption, Hydrogen ion concentration, Water pollution effects.

The toxic effects and accumulation of the heavy metals, Cd, Cu, and Zn by the sheath forming blue-green alga Chroococcus paris were investigated. All three of the metals were bound rapidly. Approximately 90% of the total amount of the added metal was bound within 1 min. Further significant binding occurred at a slower rate. The maximum metal binding capacity, as determined by filtration studies, was determined to be 53, 120, and 65 mg/g dry algal weight for Cd, Cu, and Zn, respectively. Binding curves for the metals followed the Langmuir adsorption isotherm model. The amount of metal bound increased with increasing pH. Metal binding increased significantly when pH was increased from 4 to 7. Nearly all of the metal was found to be rapidly EDTA extractable. Metals were found to be increasingly toxic to growing cultures in the order, Zn, Cd, and Cu. All of the metals studied exhibited toxic effects at concentrations greater than 1.0 mg/L. The lowest concentrations used which showed detectable toxicity were 0.1 mg/L for Cu and > 0.4 mg/L for Cd and Zn. (Authors' abstract)
W85-02922

**BIOACCUMULATION AND TISSUE DISTRIBUTION OF MERCURY - HGCL2 AND CH3HGCL - IN SALMO GAIRDNERI AFTER DIRECT CONTAMINATION (BIOACCUMULATION ET REPARTITION TISSULAIRE DU MERCURE - HGCL2 ET CH3HGCL - CHEZ SALMO GAIRDNERI APRES CONTAMINATION PAR VOIE DIRECTE),**
Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Fondamentale et d'Ecotoxicologie.
F. Ribeyre, and A. Boudou.
Water, Air, and Soil Pollution, Vol. 23, No. 2, p 169-186, August, 1984. 9 Fig, 4 Tab, 7 Ref.

Descriptors: *Bioaccumulation, *Tissue distribution, *Mercury, *Trout, *Direct contamination, Fish, Heavy metals, Water pollution effects, Tissue analysis.

Salmo gairdneri specimens were directly contaminated with mercury compounds (HgCl2 and CH3HgCl) for 30 days. The kinetics of mercury accumulation in the whole fish following direct contamination was characterized by a sigmoid curve; both the mercury concentrations and mercury contents showed this tendancy. During the experimental period the weight of the fish did not change significantly. Mercury accumulation in the fish was much greater when methylmercury was used (6 times greater after 30 days exposure). After exposure to HgCl2, the muscle and the gills contained no less than 55% of total mercury in the fish. After exposure to methylmercury these organs contained 60% of total mercury. The blood, the liver, and the kidneys also showed a high mercury accumulation. The phenomena observed during the experimental period were influenced by two processes: the first called 'cumulative' characterized by an increase in the rate of mercury accumulation and the second one 'limitative', characterized by a progressive slowing of mercury accumulation. The comparative analysis of results obtained during direct contamination and the following decontamination period in Salmo gairdneri should permit a better understanding of bioaccumulation processes. Those organs showing a fast ratio of decontamination (donor organs) had a sigmoid profile during contamination phase. Those organs whose mercury content is increased during the decontamination period (receiver organs) showed an exponential type accumulation curve during contamination. Results obtained during trophic contamination are very different from those obtained during direct exposure, especially in the case of HgCl2 which crosses the intestinal epithelium with difficulty. (Collier-IVI)
W85-02925

**WATER FLEA (DAPHNIA MAGNA) AS A SENSITIVE INDICATOR FOR THE ASSESSMENT OF TOXICITY OF SYNTHETIC DETERGENTS,**
Industrial Toxicology Research Centre, Lucknow (India).
H. Lal, V. Misra, P. N. Viswanathan, and C. R. K. Murti.
Ecotoxicology and Environmental Safety, Vol. 8, No. 5, p 447-450, October, 1984. 1 Fig, 1 Tab, 22 Ref.

Descriptors: *Daphnia, *Toxicity, *Bioassay, *Detergents, Crustaceans, Bioindicators, Animal behavior, Behavior, Water pollution effects.

Daphnia may serve as a suitable toxic indicator for determining potential hazards to aquatic biota. Daphnia magna was used as a sensitive indicator for assessing the toxicity of synthetic detergents. Acute and chronic toxicity of detergents to the water flea was studied under laboratory conditions by following the median tolerance limit (TLM) at 48 hr and the rate of survival. The rate of reproduction decreased significantly; as compared to controls, the numbers of ecdyses were 35%, the hatches were 78%, and the neonates produced were 92%. The TLM at 48 hr was 0.013 ppm. The rate of survival decreases when increasing the concentration with time in a dose-dependent response. During the acute toxicity studies, behavioral changes were also noticed. The filter feeding behavior of daphnia may be affected on chronic exposure to detergents; the retardation in the rate of filter feeding behavior may one of the reasons for the sensitivity as well as for the decrease in the rate of reproduction of daphnia. (Collier-IVI)
W85-02943

**FATE AND BIOLOGICAL EFFECTS OF METHYL PARATHION IN OUTDOOR PONDS AND LABORATORY AQUARIA; I. FATE,**
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
For primary bibliographic entry see Field 5B.
W85-02945

**FATE AND BIOLOGICAL EFFECTS OF METHYL PARATHION IN OUTDOOR PONDS AND LABORATORY AQUARIA; II. EFFECTS,**
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
N. O. Crossland.
Ecotoxicology and Environmental Safety, Vol. 8, No. 5, p 482-495, October, 1984. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Parathion, *Water pollution effects, *Fate of pollutants, *Toxicity, Trout, Algae, Mayflies, Daphnia, Copepods, Bioassays.

Methyl parathion (MEP) applied to three outdoor ponds at a nominal concentration of 100 micro g/liter was toxic to some species of aquatic insects and crustaceans but not to fish. The spectrum of toxicity was similar to predictions based on a literature survey of data obtained from laboratory tests. Various secondary effects occurred that could not be predicted from laboratory toxicity tests. An increase in populations of Diaptomus in treated ponds was probably caused by mortality of predators and competitors. A bloom of filamentous algae which then collapsed, leading to severe depletion of dissolved oxygen and fish deaths, may have been triggered by mortality of herbivorous mayflies and daphnids. The growth of juvenile rainbow trout in treated ponds was significantly less than in untreated ponds. On the other hand their growth in laboratory aquaria was not affected when rainbow trout were exposed to higher concentrations of MEP than occurred in the outdoor ponds. It was concluded that growth of rainbow trout in the ponds was probably affected by mortality among aquatic insects and crustaceans on which they feed. (Author's abstract)
W85-02946

**CRUSTACEAN PLANKTON IN NORTHEASTERN ONTARIO LAKES SUBJECTED TO ACIDIC DEPOSITION,**
Ontario Ministry of the Environment, Sudbury.
For primary bibliographic entry see Field 2H.
W85-02954

**EFFECTS OF EFFLUENTS FROM A SEWAGE TREATMENT PLANT ON THE AQUATIC ORGANISMS,**
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Biological Sciences.
A. A. Oladimeji, and J. W. Wade.
Water, Air and Soil Pollution, Vol. 23, No. 3, p 309-316, October, 1984. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Ecological effects, *Wastewater treatment, *Zaria, *Nigeria, *Kubanni River, Water pollution effects, Conductivity, Hydrogen ion concentration, Chemical oxygen demand, Heavy metals, Bioindicators, Algae, Aquatic insects, Crustaceans, Rotifers, Fish.

The effects of sewage pollution on the distribution and abundance of some organisms over a period of 4 mo at the Ahmadu Bello University Main Campus sewage treatment plant and Kubanni river were studied. Physical-chemical parameters such as dissolved oxygen; temperature; hydrogen ion concentration (pH); electrical conductivity and chemical oxygen demand influenced by pollution were measured with respect to the population of aquatic organisms. The organisms were used as biological indices to monitor the ecological imbalance caused by the effluent. The variations in concentrations of some heavy metals were also measured. The studies revealed that at the source of pollution there were no organisms except for some insect larva such as Eristalis, Psychoda, and some microscopic algae like Oscillatoria, Anaebaena, and Polysystis. A location (site 5) on Kubanni river just before the confluence of the sewage effluent and the river was taken as the control. There was a wide variety of organisms (crustaceans, rotifers, and fish) at the control point. (Author's abstract)
W85-02955

**EFFECT OF SIMULATED ACID PRECIPITATION ON NITROGEN MINERALIZATION AND NITRIFICATION IN FOREST SOILS,**
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
N. J. Novick, T. M. Klein, and M. Alexander.
Water, Air and Soil Pollution, Vol. 23, No. 3, p 317-330, October, 1984. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Acid rain, *Nitrogen, *Mineralization, *Nitrification, *Soil chemistry, Hydrogen ion concentration, Isotope studies, Ammonium, Adirondacks, New York.

After exposure of samples of three forest soils (pH 3.4 to 3.9) from the Adirondacks region of New York to 60, 230, or 400 cm of simulated rain of pH 3.5 or 5.6 in 4, 14, or 24 weeks, respectively, the soil samples were separated into the 0 to 2 and 2 to

5 cm organic layers and further incubated. The rates of N mineralization in Woods soils exposed to the simulated precipitation were less for rain at pH 3.5 than at pH 5.6, but the inhibition decreased with increasing exposure of the 0 to 2 cm layer. In Panther soil, the rates of mineralization were usually not affectd by the acidity of the simulated rain. In the upper layer of Sagamore soil, mineralization was not influenced by the pH of the simulated rain, but the transformation was faster in the bottom layer of soil after prolonged exposure to simulated rain at pH 3.5 than at pH 5.6. The rate of nitrate formation in Panther and Woods soils amended with ammonium was inhibited by the more acid rain. Studies with labeled NH4 indicated that ammonium was oxidized to nitrate even though ammonium levels did not decline or declined only slightly after prolonged exposure of Panther or Woods soil to rain at pH 3.5. The growth of orchardgrass in Panther and Woods soil was inhibited by the more acid simulated rain. (Author's abstract)
W85-02956

**EFFECTS OF FIVE INSECTICIDES ON ZYGOSPORE GERMINATION AND GROWTH OF THE GREEN ALGA CHLAMYDOMONAS MOEWUSII,**
Illinois State Univ., Normal. Dept. of Biological Sciences.
J. R. Cain, and R. K. Cain.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 571-574, November, 1984. 2 Tab, 7 Ref.

Descriptors: *Water pollution effects, *Insecticides, *Algal growth, Toxicity, Aldicarb, Carbaryl, Dichlorvos, Propoxur, Trichlorfon, Organic compounds, Germination, Spores.

The effects of exposure to aldicarb, carbaryl, dichlorvos, propoxur, and trichlorfon were investigated using Chlamydomonas moewusii. Carbaryl and trichlorfon produced significant growth inhibition over the concentration range tested. No such inhibition was demonstrated by the other insecticides. Carbaryl significantly inhibited zygospore germination. No statistically significant effects on germination were produced by the other 4 insecticides. This is the first study to demonstrate that an insecticide can produce toxic effects on an algal spore, and illustrates the need for further toxicity studies involving reproductive stages of algal life histories. (Baker-IVI)
W85-02966

**LOW CONCENTRATION EFFECTS OF ENDOSULFAN INSECTICIDE ON REPRODUCTIVE BEHAVIOUR IN THE TROPICAL CICHLID FISH SAROTHERODON MOSSAMBICUS,**
Tropical Development and Research Inst., London (England).
P. Matthiessen, and J. W. M. Logan.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 575-583, November, 1984. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Endosulfan, *Cichlids, *Pesticide toxicity, *Fish behavior, *Reproduction, Fish populations, Organic compounds.

The interruption of the cichlid reproductive behavior by endosulfan was investigated. Endosulfan at 0.5 microg/l had no apparent effect on breeding behavior in young adults. However, many of the newly-hatched fry died through exposure to their 24 hr LC50. Four weeks exposure to 0.5 micro g/l endosulfan produced no pathological signs in ovary or testis tissue. In a second experiment juvenile fish were exposed to 0.6 micro g/l levels of endosulfan. Originally the juveniles showed no signs of reproduction. After about 12 days those in the control tank began to demonstrate sexual behavior while those in the treated tank did not. Dosed males fed poorly, floated with heads higher than tails, and were abnormally sensitive to sudden audial or visual stimuli. Control females started laying eggs after 18 days, while dosed females did not start laying until day 30, but the differences in numbers of eggs was not significant. The concentration of 11-ketoestrosterone in male fish was elevated after exposure to endosulfan at 0.6 micro g/l, but not significantly so. No deleterious effects in either sex were observed at 0.2 micro g/l. (Baker-IVI)
W85-02967

**TERATOGENIC AND LETHAL EFFECTS OF PARAQUAT ON DEVELOPING FROG EMBRYOS (RANA PIPIENS),**
Indiana State Univ., Terre Haute. Dept. of Life Sciences.
N. A. Dial, and C. A. Bauer.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 592-597, November, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Water pollution effects, *Herbicides, *Paraquat, *Frogs, Amphibians, Organic compounds, Teratogenesis.

Lethal and gross teratogenic effects of a range of concentrations of paraquat on Rana pipiens embryos were investigated, including concentrations at the recommended aquatic field application rates. Eggs were exposed at early gastrula to 0, 0.1, 0.5, 2.0, and 10.0 ppm paraquat. Eggs were very resistant as development proceeded normally to hatch. At 3 days post hatch a significant increase was noted in mortality of all treatment groups, except the 0.1 ppm exposed group. No tadpoles subjected to 2 and 10 ppm paraquat survived beyond 11 days after treatment. Survivability was very poor at 0.5 ppm exposure levels with only 5.5% living to day 12. Growth rate was slowed in all treated groups, but only slightly so in embryos exposed to 0.1 ppm. A trend was also observed in maximum size attained by embryos exposed to the various dose levels of paraquat. A significant number of tadpoles exposed to levels of 0.5 ppm and above were observed to have abnormal tail development by day 5. Exposure of embryos to concentrations over 0.1 ppm produced profound effects on motor ability. After hatch, aquatic application levels of paraquat caused death, retardation of growth, significant levels of multiple tail malformations, poor head development, and produced profound effects on motor ability. Paraquat disappears from treated water quite rapidly and therefore the timing of paraquat application to aquatic ecosystems could be of utmost importance to R. pipiens. (Baker-IVI)
W85-02968

**ACUTE TOXICITY OF HYDRAZINE HYDRATE TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS) AND DAPHNID (DAPHNIA PULEX),**
Duke Power Co., Huntersville, NC. Environmental Services Section.
J. S. Velte.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 598-604, November, 1984. 2 Tab, 16 Ref.

Descriptors: *Water pollution effects, *Hydrazine, *Daphnia, *Minnows, Organic compounds, Industrial wastes, Antioxidants, Toxicity, Invertebrates, Fish.

Hydrazine is a strong antioxidant which is used to deoxygenate boiler water. Hydrazine may enter the aquatic environment as controlled industrial discharge or as a result of an accidental spill. Two 48-hr static renewal tests were used to expose D. pulex to hydrazine hydrate. The highest nominal hydrazine exposure concentrations were 5.00 and 4.00 mg/L in two daphnid tests. The daphnids were observed at 3, 6, 12, 24, 36, and 48 hr for immobilization. Fathead minnows were tested using a flow-through acute test procedure using exposure concentrations of 1.12, 2.25, 4.50, 9.00, and 18.00 mg hydrazine/L. Daphnids were far more sensitive to hydrazine than were fathead minnows during equivalent lengths of exposure. After 48 hr the LC50 value for fathead minnows (5.98 mg/L) was approximately 33 times greater than the comparable value for daphnids (0.18 mg/L). Dissolved oxygen concentrations in the exposure chambers were affected only slightly by the hydrazine concentrations tested. Hydrazine decays readily in the environment due to its reactivity. The rate of degradation is closely related to the temperature, receiving water chemistry, and the amount of suspended particulate material present. (Baker-IVI)
W85-02969

**SELENIUM EFFECTS ON ANTENNAL INTEGRITY AND CHRONIC COPPER TOXICITY IN DAPHNIA PULEX (DEGEER),**
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 605-611, November, 1984. 2 Fig, 20 Ref.

Descriptors: *Water pollution effects, *Copper, *Selenium, *Daphnia, Minerals, Toxicity, Heavy metals, Essential nutrients, Water quality standards.

The effect of sodium selenite on the incidence of antennal damage in cohorts of D. pulex exposed to copper in a soft, reconstituted water was examined. Tests were run in water to which had been added (ppb): 0 Cu - 0 Se, 10 Cu - 0 Se, and 10 Cu - 5 Se. The cohort reared in water containing 10 ppb Cu and no added Se began to exhibit antennal damage on day 28 of the experiment and all animals exhibited antennal damage by day 32. The cohort reared in water containing 10 ppb Cu and 5 ppb Se exhibited no antennal damage over the 42 day exposure. In the absence of both Cu and Se, only one animal developed antennal damage and that was late in the experiment. Se addition not only eliminated antennal damage, it also significantly reduced the chronic toxicity of Cu as evidenced by an increase in survival. Se should thus be included as one of the essential nutrients in lab cultures of daphnids and this metal will have to be added to the increasing list of water quality parameters which must be considered when delivering water quality criteria and standards for metal toxicity. (Baker-IVI)
W85-02970

**EFFECT OF PH ON PENTACHLOROPHENOL TOXICITY TO EMBRYOS AND LARVAE OF ZEBRAFISH (BRACHYDANIO RERIO),**
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
G. Dave.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 621-630, November, 1984. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Acidity, *Pentachlorophenol, *Toxicity, *Fish, *Water pollution effects, Acid rain, Organic compounds, Industrial wastes, Hydrogen ion concentration.

A simple laboratory procedure was sought for the determination of the effect of pH on the toxicity of various chemicals added to or already present in various samples of ground and surface waters. In experiment 1, ten eggs were exposed to 50 mL pH-adjusted and buffered water. In experiment 2, ten eight-day-old larvae were exposed to pH-adjusted and buffered water with pentachlorophenol (PCP) added to nominal concentration between 0.3 and 640 micro g/L. Three series with nominal pHs of 5, 7, and 9 and a control series, without buffer were tested simultaneously. In experiment 3 the embryos were 30-32 hr old; PCP was added to nominal concentrations of 0, 10, 20, 40, 80, 160, 320, and 640 micro g/L at pH 4, 5, 6, 7, 8, and 9. At high pH values there are long-term effects of PCP resulting in a slightly reduced period of survival in unfed larvae, presumably because of less efficient use of energy through uncoupling of oxidative phosphorylation. (Baker-IV)
W85-02971

**COAL ASH BASIN EFFECTS (PARTICULATES, METALS, ACIDIC PH) UPON AQUATIC BIOTA: AN EIGHT-YEAR EVALUATION,**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
D. S. Cherry, R. K. Guthrie, E. M. Davis, and R. S. Harvey.

Water Resources Bulletin, Vol. 20, No. 4, p 535-544, August, 1984. 5 Fig, 3 Tab, 65 Ref.

Descriptors: *Coal ash, *Particulates, *Metals, *Acidity, *Aquatic life, Aquatic insects, Mosquitofish, Invertebrates, Effluents, Water pollution effects, Biological magnification, Arsenic, Cadmium, Chromium, Copper, Selenium, Zinc, Macrophytes.

Coal ash effluent effects including particulates, acidic pH excursions, elemental concentrations and bioconcentration in selected organisms have been studied as changes in water quality and densities of benthic macroinvertebrate and mosquitofish (Gambusia affinis) populations in a swamp drainage system over an eight-year period. Three changes in the ash basin settling system were made between mid-1973 and January 1982. Initial density of the aquatic biota was altered severely by heavy ash siltation, followed by acidic pH excursions, and perhaps overall by elemental concentrations and bioaccumulation. Heavy ash siltation, followed by acidic pH excursions (mean of 5.5, extreme of 3.5) after the addition of fly ash to the original settling basin system, had the most profound effect on biota. Dipterans (chironomids) and some odonates (Plathemis lydia and Libellula spp.) were resistant to heavy siltation, while mosquitofish, which showed no discernible responses to ash siltation, were absent at acidic pH, along with the few previously surviving invertebrate populations. Elemental concentrations of arsenic, cadmium, chromium, copper, selenium, and zinc did not appear to limit aquatic flora and fauna on a short-term, acute basis. Long, chronic elemental exposures may have been instrumental in retarding the recovery of all forms of aquatic life in the receiving system. Elemental concentrations (except for arsenic and selenium) in the receiving system were generally one to two orders of magnitude higher than the Water Quality Criteria set by the U.S. Environmental Protection Agency (1980) for protection of aquatic life for the minimum and 24-hour mean values. From collective elemental exposures in the receiving system, bioconcentration factors in macrophytes, invertebrates and fish were generally lower than those reported in the literature for laboratory, single elemental concentrations. By 1978, when the new settling basin systems were operating effectively, invertebrate populations were largely recovered, and mosquito-fish populations recovered within one year afterward. (Author's abstract)
W85-02980

**OLIGOHALINE BENTHIC INVERTEBRATE COMMUNITIES AT TWO CHESAPEAKE BAY POWER PLANTS,**

Hampton Inst., VA. Center for Marine and Coastal Environmental Studies.
R. A. Jordan, and C. E. Sutton.
Estuaries, Vol. 7, No. 3, p 192-212, September, 1984. 20 Fig, 9 Tab, 39, Ref.

Descriptors: *Nuclear powerplants, *Invertebrates, *James River, *Saltpeter Creek, *Maryland, *Thermal pollution, Water pollution effects, Estuarine environment, Cooling water, Benthic fauna, Tidal creeks, Oligohaline environment.

Benthic invertebrate populations at the Surry power plant on James River, Virginia and the C.P. Crane power plant on Saltpeter Creek, Maryland exhibited large spatial and temporal variations. At C.P. Crane, where the cooling water is pumped between two tidal creeks, populations in the receiving creek exhibited five response patterns: 1) mitigation of a winter dieoff (Rangia cuneata, a brackish water clam), 2) acceleration of growth or development (R. cuneata; Scolecolepides viridis, a polychaete; Leptocheirus plumulosus, an amphipod; Tubificidae; and Coelotanypus sp., a dipteran), 3) importation of larvae from the source water creek (S. viridis and Coelotanypus sp.), 4) extension of creek-dwelling species into the adjacent river (Coelotanypus sp. and other dipterans), and 5) increased severity of late summer population depression (S. viridis and L. plumulosus). At Surry, where the cooling water is taken from the downriver side of a peninsula and discharged on the upriver side, there was no confined creek system at the discharge, and effects were less pronounced. The community in the Surry discharge zone resembled the community at downriver stations more closely than at upriver reference stations. The L. plumulosus population near the Surry discharge was depressed, while the Mytilopsis leucophaeta population was enhanced. No major ecological damage was attributed to either power plant, due in part to the resilience of estuarine endemic populations, but the unique features exhibited by each of the two sites support the argument that oligohaline estuarine zones should not be designated a priori for unregulated industrial development. (Author's abstract)
W85-02994

**INFLUENCE OF CHLORINE ON THE SUSCEPTIBILITY OF STRIPED BASS (MORONE SAXATILIS) TO VIBRIO ANGUILLARUM,**

Maryland Univ., College Park. Dept. of Microbiology.
F. M. Hetrick, L. W. Hall, Jr., S. Wolski, W. C. Graves, and B. S. Roberson.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 9, p 1375-1380, September, 1984. 5 Tab, 29 Ref. Maryland DNR grant P-84-81-04.

Descriptors: *Chlorine, *Toxicity, *Bass, *Vibrio, Water pollution effects, Pathogenic bacteria, Infection, Mortality, Immunity.

The subtle effects that low levels of pollutants have on fish populations are probably more important than the effects of large spills, since the effects are less likely to be obvious and the source more difficult to detect in time to save the environment. An experiment was carried out to determine if exposure of striped bass to sublethal concentrations of chlorine affected their susceptibility to bacterial infection. Exposure of striped bass for 96 h to sublethal concentrations of total residual chlorine (TRC) (0.05-0.23 mg/L) did not increase their susceptibility to infection with the bacterial pathogen Vibrio anguillarum. Variables examined were TRC concentrations, length of exposure to chlorine, and the order of exposure to chlorine and the pathogen. Mortalities in the groups exposed to both chlorine and pathogen were not significantly different from those seen in groups receiving the bacteria only. Smaller fish are more susceptible than larger fish, and the LD50 is markedly affected by the ambient temperature in that fewer bacteria are needed to kill fish at lower temperatures. One contributing factor to this increased resistance of fish at higher water temperatures appears to be related to their immune status. (Moore-IVI)
W85-03001

**EFFECTS OF A SETTLED INDUSTRIAL DOMESTIC SEWAGE WORKS EFFLUENT FROM PERCOLATING FILTERS ON THE EMBRYO VIABILITY AND HATCHING SUCCESS OF RAINBOW TROUT, SALMO GAIRDNERI RICHARDSON,**

Aston Univ., Birmingham (England). Dept. of Chemistry.
J. A. L. Fraser, and E. R. Clark.
Journal of Fish Biology, Vol. 25, No. 4, p 393-403, October, 1984. 5 Tab, 34 Ref.

Descriptors: *Trout, *Water pollution effects, *Effluents, *Microorganisms, *Embryonic growth stage, Hatching, Mortality, Sphaerotilus, Eleutheroembryos, Wastewater pollution.

Survival of juvenile stages and the growth and reproductive capacity of larger fish may be adversely affected in streams or rivers which receive effluents giving rise to prodigious growths of 'sewage fungus'. 'Sewage fungus' is a community of mostly heterotrophic organisms forming slime growth in organically polluted water. Embryo viability, hatching success and eleutheroembryo survival in tap water, 50% and 100 settled effluent were investigated in rainbow trout embryos when one group of embryos was washed twice daily and the other group was not washed. Differences in the hatching success between washed and unwashed embryos in the three treatments were compared to the effect of saprophytic microbial growths assessed. There was a significant difference in mortality between washed embryos to tap water (5%) and 50% effluent (12%) and 100% effluent (12%) when dissolved oxygen levels maintained near 100% air saturation value. Mortalities of unwashed embryos were 4%, 26%, and 26% respectively for the three treatments. After 10 days exposure unwashed embryos in the effluent treatments had become covered in microbial growths, among which Sphaerotilus spp. were identified. Hatching success of washed embryos was similar in the three treatments but unwashed embryos were significantly affected by the effluent treatments. The presence of Sphaerotilus spp. was the major cause of unsuccessful hatching in both effluent treatments. All eleutheroembryos that hatched and settled to the debris in the bottom of the fry tanks died within 3 days in 100% effluent and within 14 days in 50% effluent. All eleutheroembryos maintained in the water column through cage retention died within 18 days in 100% effluent, while 33% reached the swim-up phase in 50% effluent. (Moore-IVI)
W85-03002

**INTERACTIONS OF TEMPERATURE AND SUBLETHAL ENVIRONMENTAL COPPER EXPOSURE ON THE ENERGY METABOLISM OF BLUEGILL, LEPOMIS MACROCHIRUS RAFINESQUE,**

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
P. A. Felts, and A. G. Heath.
Journal of Fish Biology, Vol. 25, No. 4, p 445-453, October, 1984. 4 Fig, 27 Ref.

Descriptors: *Water temperature, *Copper, *Toxicity, *Bluegill, Oxygen consumption, Heavy metals, Metabolism, Temperature acclimation, Water pollution effects.

Copper (0.21 mg/l) caused a decreased in whole body oxygen consumption in bluegills exposed for 32 days, but no changes occurred during days 3, 4 or 9 of copper exposure. In vitro oxygen consumption of gill and brain, were not significantly altered, whereas liver QO2 was slightly elevated which suggests that copper is acting to decrease oxygen consumption of the whole animal at a higher level of integration than these individual tissues. In fish subjected to an increase in temperature as well as sublethal copper exposure, whole body oxygen consumption was higher than controls 5 days after the temperature was increased, indicating a delay in temperature acclimation in the copper exposed fish. This difference was reflected in higher in vitro oxygen consumption in the liver and gill of these fish suggesting the metal was delaying the process of temperature acclimation by at least in part acting directly on the tissues. (Author's abstract)
W85-03003

**PREDICTED SURVIVAL OF THE BAY ANCHOVY (ANCHOA MITCHILLI) IN THE HEATED EFFLUENT OF A POWER PLANT ON GALVESTON BAY, TEXAS,**

Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
K. S. Chung, and K. Strawn.
Environmental Biology of Fishes, Vol. 7, No. 1, p 57-62, January, 1982. 1 Fig, 2 Tab, 29 Ref.

Descriptors: *Thermal pollution, *Entrainment, *Powerplants, *Anchovy, *Galveston Bay, *Texas, Cooling water, Fish, Mortality, Cooling towers.

The P.H. Robinson Generating Station, Bacliff, Texas, uses the Galveston estuarine system as a cooling water resource. Five supplemental cooling towers operate during June through September. Cooling water from the towers is mixed with the hot discharge water and the temperature is lowered to 35 C or less in summer. Bay anchovy (Anchoa mitchilli) collected from the intake canal were tested for 180 min at various constant temperatures during June 1974 through September 1975 to determine if they could survive passage through the discharge canal system. Three-h survival temperatures were significantly lower, throughout the year, than the temperatures in the discharge canal both afferent and efferent to the

cooling towers. The bay anchovy entrained and entrapped from the intake canal and exposed to the heated effluent could not survive in the cooling water systems. The cooling towers should aid survival of the fish in the canal below the towers. (Moore-IVI)
W85-03022

ACUTE TOXICITY OF AMMONIA AND COPPER TO THE GASTROPOD POTAMOPYRGUS JENKINSI (SMITH),
Aston Univ., Birmingham (England).
For primary bibliographic entry see Field 5A.
W85-03042

TOXICITY OF LOWER THAN PERMISSIBLE LEVELS OF CHROMIUM (VI) TO THE FRESHWATER TELEOST NURIA DENRICUS,
Centre for Water Resources Development and Management, Calicut (India).
S. A. Abbasi, and R. Soni.
Environmental Pollution (Series A), Vol. 36, No. 1, p 75-82, 1984. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Chromium, *Fish, *Toxicity, *Water pollution effects, Metals, Bioassay, Hexavalent chromium.

The impact of chromium (VI) on the freshwater teleost Nuria denricus in concentrations ranging from 0 to 100 mg/liter was studied by computer-aided long-term static bioassays. Hexavalent chromium induced marked changes in swimming and balancing patterns. The stressed fishes exhibited erratic and rapid twisting movements, loss of balance, increased frequency of surfacing and vertical swimming compared with the smooth and predominantly horizontal swimming of fishes in the control aquaria. A marked effect on feeding was noted above 2.0 mg/liter. Fishes exposed to 0-2 mg/liter chromium consumed food completely, while in exposures of 5-100 mg/liter food consumption was lower than normal with a clear trend towards loss in food consumption with increase in chromium concentration. The stress gradually led to sluggishness and death. Chromium also caused erosion of fins and fin rays. (Baker-IVI)
W85-03043

TOXICITY OF AMMONIA TO EARLY LIFE STAGES OF THE GREEN SUNFISH LIPOMIS CYANELLUS,
Environmental Research Lab.-Duluth, MN.
J. H. McCormick, S. J. Broderius, and J. T. Fiandt.
Environmental Pollution (Series A), Vol. 36, No. 2, p 147-163, 1984. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Sunfish, *Toxicity, *Ammonia, Lake Superior, Water pollution effects, Fish, Growth stages, Hydrogen ion concentrations, Hatching.

Toxicity of ammonia to early life stages of green sunfish Lepomis cyanellus was studied. One chronic and four acute exposure studies were conducted. During the chronic study green sunfish were exposed to a series of ammonia concentrations from the blastula stage through 40 days post hatching. During the acute studies, juvenile green sunfish were exposed at four pH levels, 6.6., 7.2, 7.7, and 8.7, to derive 3-, 6-, 12-, 24-, 48-, 72-, and 96-hr LC50 and EC50 concentrations of un-ionized and total ammonia. Embryos of the green sunfish were relatively resistant to adverse effects of ammonia. Hatching success was not affected by concentrations as high as 0.91 mg/liter NH3. Growth was, however, significantly reduced from that of control fish at a concentration between 0.22 and 0.49 mg/liter NH3. Particularly sensitive was the critical period when the larvae first require exobenous food to survive. Growth was the most sensitive measure of chronic effect. Growth at the two lowest ammonia treatments was actually elevated above that of the control fish exposed to unaltered Lake Superior water. (Baker-IVI)
W85-03045

EFFECT OF TERRESTRIAL HERBICIDES ON THE COMMUNITY STRUCTURE OF STREAM PERIPHYTON,
Texas A and M Univ., College Station. Dept. of Biology.
R. J. Kosinski.
Environmental Pollution (Series A), Vol. 36, No. 2, p 165-189, 1984. 1 Fig, 8 Tab, 54 Ref.

Descriptors: *Herbicides, *Periphyton, *Toxicity, *Water pollution effects, Atrazine, Trifluralin, Paraquat, Algae, Standing crop, Species composition.

The influence of 0.1, 1 and 10 mg/kg of the herbicides atrazine, trifluralin, MSMA and paraquat on the species composition and standing crop of algal periphyton was assessed using artificial streams. For each herbicide, two experiments were performed; one using algae from a pristine spring and another using algae from a stream heavily influenced by agricultural runoff. Also, in each experiment 0.01 mg/kg of the test herbicide was maintained in the water of half the streams during a three-week period prior to the application of the 0.1/1/10 mg/kg treatments in an attempt to induce development of a resistant community. Calculated half lives were 3.2 days for atrazine, 51 min for trifluralin, and 13.1 hr for paraquat. MSMA's half life was 2.3 days in 1981 and 5.9 days in 1982. Both univariate and multivariate tests rarely disclosed a significant chronic x acute interaction term. Diversity was a poor indicator of herbicide effects. Atrazine caused the most extensive damage. The spring community seemed more resistant than the stream community to both atrazine and paraquat. The 0.01 mg/kg did not appear to induce resistance to any of the herbicides. (Baker-IVI)
W85-03046

BACTERIAL ACTIVITY IN SEDIMENTS OF LAKES RECEIVING ACID PRECIPITATION,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W85-03047

EFFECTS OF LEAD TAILINGS ON BENTHOS AND WATER QUALITY OF THREE OZARK STREAMS,
Missouri Dept. of Conservation, Columbia.
R. M. Duchrow.
Transactions of the Missouri Academy of Science, Vol. 17, No. 2, p 5-17, 1983. 8 Fig, 1 Tab, 30 Ref.

Descriptors: *Lead mines, *Mine wastes, *Water pollution effects, *Saline Creek, *Logan Creek, *Little St. Francis River, *Missouri, Sedimentation, Smothering, Abrasion, Benthic fauna, Invertebrates, Aquatic insects, Fish, Heavy metals.

Lead mine tailings were discharged into two Missouri Ozark streams (Saline and Logan creeks) on March 28-29, 1977 following heavy rainfall and runoff. Sedimentation caused severe damage to benthic invertebrate communities inhabiting the receiving streams. Adult fish populations seemed unaffected; no dead fish were found during each study. Degradation in a secondary receiving stream (Little St. Francis River) was limited to the reduction of pollution-sensitive mayfly and stonefly taxa. Benthic invertebrate communities began to recover in both study streams about 2 months after the tailings discharges, but still showed signs of adverse effects after 1 year. Dissolved heavy metal concentrations never reached acutely toxic levels in either stream. Their concentrations were also below safe limit guidelines for the protection of aquatic life in most samples. The cause of degradation in both streams was primarily the physical effects of the tailings (sedimentation, smothering, and abrasion). Heavy metals did not appear to contribute significantly to the degradation of the biota of either stream. Effects on early life stages of fish and benthos were not studied. (Author's abstract)
W85-03068

SOME EFFECTS OF EUTROPHICATION AND THE REMOVAL OF AQUATIC PLANTS BY GRASS CARP (CTENOPHARYNGODON IDELLA) ON RAINBOW TROUT (SALMO GAIRDNERII) IN LAKE PARKINSON, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Rotorua (New Zealand). Fisheries Research Div.
D. K. Rowe.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 2, p 115-127, July, 1984. 7 Fig, 4 Tab, 40 Ref.

Descriptors: *Eutrophication, *Aquatic weed control, *Trout, *Grass carp, *Lake Parkinson, *New Zealand, Stratification, Dissolved oxygen, Shag, Predation, Cladocerans, Phytoplankton, Ammonia, Fish populations.

Temporary removal of aquatic plants in Lake Parkinson, a small, eutrophic dune lake, resulted in a number of changes to the population of stocked rainbow trout (Salmo gairdnerii). During each summer the lake stratified and low oxygen levels limited the distribution of trout to shallow (0-4 m) surface waters. In the first summer following weed removal the numbers of black shags (Phallacrocorax carbo) counted at the lake increased, and their predation resulted in a decline in trout density. However, the growth rate and condition of the trout population then exceeded that of trout present before weed removal. During the second summer after weed removal a cladoceran bloom was followed by low phytoplankton levels and high ammonia concentrations. A prolonged calm compounded this situation with the result that oxygen levels in bottom and surface waters dropped below 2 ppm. These low oxygen levels eliminated the trout population, but other fish species present survived. Elimination of aquatic plants affected the population dynamics of other fish species in the lake with potential implications for the trout. The experiment demonstrated the importance of weed beds in maintaining a stable fish community in lakes such as Lake Parkinson. (Author's abstract)
W85-03072

EFFECTS OF SIMULATED ACID PRECIPITATION ON DECOMPOSITION AND LEACHING OF ORGANIC CARBON IN FOREST SOILS,
Bemidji State Univ., MN. Center for Environmental Studies.
F.-H. Chang, and M. Alexander.
Soil Science, Vol. 138, No. 3, p 226-234, September, 1984. 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Acid rain, *Forest soils, *Leaching, *Decomposition, *Organic carbon, *New York, Simulation, Organic matter, Mineralization, Water pollution effects.

Soil samples from three watersheds of New York State were treated with simulated rain at pH 3.5, 4.1, and 5.6 daily for 14 d, at 12 3-d intervals in three separate tests, or at 22 7-d intervals. Except for one system of treating the three forest soils, simulated acid rain reduced the amount of organic matter leached from samples of soil from which more than 0.05% of the organic carbon was leached during the exposure period. In the soil samples representing the exceptions, acid rain enhanced the leaching of organic matter. Samples from the organic layer of the treated samples of acid soil were taken at two equal depths, and the rates of organic matter decomposition in the two layers were studied. As compared with simulated rain at pH 5.6, simulated acid rain reduced the decomposition of organic matter in the three soils at both depths in three of the five tests and at both depths of two of the soils in the fourth test. In some instances, organic matter decomposition was enhanced by the simulated acid rain. Except for the sample of soil at the highest initial pH, carbon mineralization was inhibited in soils and treatments in which simulated acid rain reduced the amount of organic carbon leached, and its was stimulated in soils and treatments in which the quantity of organic carbon leached was increased by the simulated acid rain. (Author's abstract)
W85-03095

CHANGING MACROINVERTEBRATE COMMUNITY STRUCTURE AND DIVERSITY IN AN ORGANICALLY LOADED RIVER DURING ITS SELFPURIFICATION,

Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
S. G. Kovachev.
Hydrobiology (Bulgarian Academy of Science), Vol. 21, p 29-33, May 1984. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Mesta River, *Bulgaria, *Species diversity, *Organic loading, Species composition, Saprobity, Mesosaprobic rivers, Polysaprobic rivers, Self purification, Ecological effects, Water pollution effects, Fate of pollutants.

Information-theoretical community structure indices were calculated for macroinvertebrate samples obtained on the Mesta River, Bulgaria. Fifteen stations were distributed along a gradient of decreasing organic loading between just below Razlog and just downstream from Gotse Delchev. Community diversity tended to vary in parallel with number of species and individuals, whereas redundancy was high when a few species dominated. Water quality according to the saprobic system ranged from S sub R = 17.16 to S sub R = 53.07. The river environment was classified as polysaprobic at the most upstream station, and became alpha-mesosaprobic to beta-mesosaprobic at the most downstream two stations. Evenness in the macroinvertebrate community structure increased as saprobity decreased, while redundancy decreased over the same river reach. As self-purification of the stream improved the environment, community structure became more complex and increased in information content. (Rochester-IVI)
W85-03101

**BIOLOGICAL STATE OF UNDERGROUND WATERS IN THE INDUSTRIAL ZONE OF THE EASTERN PART OF THE SOFIA PLAIN (BIOLOGICHIO S'STOYANIE NA PODZEMNITE VODI V INDUSTRIALNATA ZONA NA UZTOCHNOTO ZOFIIZKO POLE),**
For primary bibliographic entry see Field 5B.
W85-03103

**OLIGOCHET WORMS COMPLEX OF THE BLAGOEVGRADSKA BISTRITSA RIVER AS AFFECTED BY SOME FACTORS OF THE ENVIRONMENT (DINAMIKA NA OLIGOKHETNIYA KOMPLEKS V REKA BLAGOEVGRADSKA BISTRITSA V ZAVISIMOST OT NYAKOI FAKTORI NA SREDATA),**
I. I. Uzunov, and N. D. Nachev.
Hydrobiology, Vol. 21, p 56-67, May, 1984. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Blagoevgradska Bistritsa River, *Oligochaetes, *Water pollution effects, Eutrophication, Saprobity, Water temperature, River flow, Species composition, Water level, Abundance.

The effect of temperature, water flow and saprobity on the specific composition and abundance of oligochaetes in the Blagoevgradska Bistritsa river in 1970 through 1975 and 1978 through 1981 were studied. A total of 230 samples were collected from 13 localities annd 35 species of 19 genera and 7 families of oligochaetes were established. The specific composition is highly dependent on the saprobic conditions. With the ongoing saprobization a primary saprobic succession develops with the specific composition reaching its highest variety under beta-mesosaprobic conditions. During the succession the specific composition and dominant species change continuously which actually are the oligochaetic saprobic sequences. The inflowing city sewage discontinue these processes and reduce considerably the oligochaetic specific composition and abundance. The number of individuals grows with the rise of temperature (r = +0.60) while at the same time the number of species stays constant, which is due to the nonsexual reproduction of the dominating Naididae worms. Because of the drift the high water level leads to reduced specific variety (r = -0.75). The saprobity was found to be the most important factor affecting the oligochaetic specific composition and abundance. Its relative value as computed was 26% of the total value of environmental factors affecting the specific composition and 49% of the value of factors affecting the abundance. The correlation between these parameters and the saprobic levels is of the parabolic pattern. The numercial correlation shows that in the lower course of the river, toxic pollutants are present, too. (Author's abstract)
W85-03104

**STUDY ON THE HEAVY METALS HAVING EFFECT ON THE WATER BIOCENOSES IN THE BACKWATERS AT ALPAR AND LAKITELEK,**
Lower-Tisza District Water Authority, Szeged (Hungary).
E. Fekete.
Tiscia (Szeged), Vol. 19, No. 2, p 3-15, 1984. 12 Fig, 13 Ref.

Descriptors: *Backwaters, *Alpar, *Lakitelek, *Tisza, *Hungary, *Heavy metals, *Water pollution effects, Copper, Cadmium, Zinc, Chromium, Mercury, Hydrogen ion concentration, Organic matter, Ammonium, Nitrates, Sodium, Potassium.

Heavy metals which have an effect on the water biocenosis were determined monthly during 1982 in the Tisza backwaters at Alpar and Lakitelek, Hungary. Copper, cadmium, zinc, chromium, and mercury contents of the water were determined. Organic matter, ammonium, nitrate, pH, sodium and potassium content were determined jointly with the studies of the heavy metals. On the basis of water quality indexes, the water qualty of Lakitelek backwater is more stable than that of the Alpar backwater. Correlations were observed between the zinc and copper content and aquatic life. The two backwaters have significant mercury content, which is due to agricultural runoff. It is striking that cadmium does not occur in significant concentrations in the backwaters. Samples originating from the bottom sediments should be included in the studies on heavy metals, to obtain complete information on equilibrium and transport process taking place in the backwaters. (Moore-IVI)
W85-03112

**BIOLOGICAL WATER QUALITY OF THE TISZA BETWEEN TOKAJ AND TISZAFURED (ON THE BASIS OF STUDIES CARRIED OUT BETWEEN THE PERIOD 1971-1980),**
Northern Hungarian Water Conservancy Directorate, Miskolc.
A. L. Vancsa.
Tiscia (Szeged), Vol. 19, No. 2, p 21-38, 1984. 15 Fig, 2 Tab, 4 Ref.

Descriptors: *Tisza, *Hungary, *Water quality, Flow discharge, Eutrophication, Water pollution effects, Fertilizers, Algae, Diatoms, Chlorophyll a, Nutrients, Phosphorus.

Water quality studies were carried out between 1971 and 1980 in the two characteristic segments of the Tisza (Tiszatardos and Tiszakeszi) in Hungary. The 10 year period can be divided into two 5-year periods, characterized by basically different flow values: with values mostly under 500 cu m/s, 1971 - 1975; and values above 500 cu m/s, 1976 - 1980 (on many occasions above 1,000 cu m/s). The water quality of the Tisza is fundamentally determined by the water output. During the period 1971 - 1980 there was a substantial increase in the utilization of chemical fertilizers. Significant degradation took place in both segments, but was greater in the Tiszakeszi segment. The cause of this may be the runoff originating from areas belonging to the channel section between the two segments. Of the biological water quality property-groups, the halobity and toxicity are favorable. The trophity shows extreme seasonal changes; it may become eutrophic at times. The C:N:P value is 2000:12:1 in the Tisza. The saprobity shows relatively balanced changes, but there is an indication of an unfavorable shift. The algae population maximums are characterized by the domination of diatoms (Bacillariophyceae). The changes in the chlorophyll-a content when the algae population maximums are subsiding are correlated with the changes in the total algal count within the longitudinal segment. Among the plant-nutrients, dissolved reactive phosphorus is regarded as a limiting factor. The water quality of the Tisza is acceptable in general; nevertheless, the results characteristic of unfavorable conditions cannot be ignored. (Moore-IVI)
W85-03113

**RELATIONSHIP BETVEEN THE CHEMICAL OXYGEN DEMAND, SUSPENDED MATTER CONTENT AND ALGAL COUNT IN THE EASTERN MAIN CANAL (HUNGARY),**
Magyar Tudomanyos Akademia, Budapest. Station for Danube Research.
K. T. Kiss.
Tiscia (Szeged), Vol. 19, No. 2, p 39-48, 1984. 4 Fig, 15 Ref.

Descriptors: *Eastern Main Canal, *Hungary, *Chemical oxygen demand, *Suspended solids, *Algae, Floods, Velocity, Canals, Organic matter.

The Eastern Main Canal is a 100 km long artificial stream conducted from the Tisza river at Tiszalok (535 river km) with the rate of flow 30-50 cu m/s. The investigations were carried out in the Eastern Main Canal at the section between Tiszalok and Balmazujvarous in 1968-1975. The amount of suspended matter changed from 5-700 mg/l, the values of chemical oxygen demand (COD) varied from 3-15 mg/l and that of the algal count from 30 thousand - 20 million individuals per liter. The changes of these values depended on the floods of the Tisza river and on the current velocity of the Eastern Main Canal. The present paper reports on the degree to which the COD values were altered by the suspended matter content, and modified by that algal count, respectively (that organic material of suspended matter and algae should be taken into account; which are oxidizable in acid with potassium permanganate, since the suspended matter also comprises the algae). With the help of path-analysis it was concluded that in case of high suspended matter content, when the algal count is low, the COD is determined by the amount of suspended matter in 40-70%, and by the algal count in 0.5-0.6%. Besides low suspended matter content, when the algal count is high, the values of the chemical oxygen demand are determined in 4-10% by the amount of suspended matter content, and in 15-20% by the algal count. (Author's abstract)
W85-03114

**ALGOLOGICAL INVESTIGATIONS IN THE WATERS OF THE TISZA BASIN AT ALPAR,**
Jozsef Attila Univ., Szeged (Hungary). Dept. of Botany.
I. Kiss.
Tiscia (Szeged), Vol. 19, No. 2, p 49-58, 1984. 1 Tab, 14 Ref.

Descriptors: *Eutrophication, *Tisza Basin, *Alpar, *Hungary, *Algae, Cyanophyta, Euglenophyta, Chrysophyta, Chlorophyta, Animal wastes, Water pollution effects.

The algological investigations of the waters at the Alpar basin were continued in 1982 since the area will be a part of the Tisza-III River Barrage waterbasin. The pH in the Alpar backwater was tested monthly, and found to usually be above 8.0. During the course of the year a total of 174 species or taxa were determined. Their taxonomic distribution is as follows: Cyanophyta, 30; Euglenophyta, 47; Chrysophyta, 45; Chlorophyta, 52. Four algal blooms occurred, and through these, the role of the factors influencing the algal associations could be studied. The one-sidedly antagonistic effect of the blue-green algae, Aphanizomenon flos-aquae and Microcystis aeruginosa, was particularly striking. The mass production of these occurred in every biotope. The algal blooms of Euglena sanguinea and E. polymorpha proved that the Euglenophyta species are able to produce enormous mass productions in the dung-polluted waters. E. sanguinea blooms colored the shallow water which is rich in organic matter and covered the surface of the reed marsh with a yellowish-green, 1-2 mm thick bioseston layer. In the green mass production of this organism, in the region of the cell center, 3-4 deep-red hematochrome clumps were detectable in 10-15% of the individuals. These disappeared within 2-3 hr upon illumination, and reappeared

upon exposure to dark. This organism has been observed in Hungary several times. (Moore-IVI)
W85-03115

**RESULTS OF THE PRELIMINARY INVESTIGATIONS ON THE ALGACOMMUNITIES IN THE BACKWATER OF THE TISZA AT ALPAR,**
Lower-Tisza District Water Authority, Szeged (Hungary).
E. Dobler, and K. Kovacs.
Tiscia (Szeged), Vol. 19, No. 2, p 59-68, 1984. 5 Fig, 25 Ref.

Descriptors: *Tisza River, *Alpar Backwater, *Hungary, *Algae, Eutrophication, Water quality, Nutrients, Phosphorus, Seasonal variation, Species diversity, Phytoplankton.

The results of the studies carried out in the backwater of the Tisza at Alpar between 1976 and 1980 are briefly reviewed to determine the biological water quality of the backwater. In 1976-1977 and in 1980 the backwater was alpha-oligohalobic; due to inrush of Tisza water in 1977 and 1979, the halobity changed to beta-oligohalobic. The backwater was eutrophic and somewhat polluted. The seasonal changes characteristic to the zone were studied on the basis of the composition of the algal communities. In the studied years the tendency of changes was similar; in some cases, however, the effect of the changes in weather resulted in slight shifts. In 1982 a more detailed study was started at the Alpar backwater, in which the phytoplankton composition was examined to species level. For the demonstration of the seasonal changes regarding the algal communities the Czekanowski similarity index was used. The phytoplankton diversity of the water area was investigated by applying the Shannon-index. The chlorophyll-a and pheophytin-a concentrations were determined from the monthly samples. The algal association of the water sample taken in February completely differs from associations in other months. At that time a Synura species was dominant, with 130 million individuals/l. (Moore-IVI)
W85-03116

**STUDIES ON THE QUALITATIVE AND QANTITATIVE COMPOSITION AND THE SEASONAL CHANGES OF PHYTOPLANKTON AT THREE SAMPLING AREAS OF THE DEAD TISZA AT LAKITELEK,**
Lower-Tisza District Water Authority, Szeged (Hungary).
K. Kovacs, and E. Dobler.
Tiscia (Szeged), Vol. 19, No. 2, p 69-78, 1984. 5 Fig, 4 Ref.

Descriptors: *Tisza, *Lakitelek, *Hungary, *Phytoplankton, Seasonal variation, Backwaters, Species composition, Biomass, Diversity.

The backwater at Lakitelek is a bend cut through during river control work in the last century. The Northern section of the dead channel is part of the Kiskunsag National Park. Studies on phytoplankton were carried out at three sampling points on the dead Tisza at Lakitelek, in the Northern region. Samples were taken monthly over a period of one year, to study qualitative and quantitative composition and the seasonal changes in the phytoplankton. The biomass and diversity of phytoplankton were measured on the basis of the total algal count. Cluster analysis was used to determine what similarities in time and space are manifested by the algal communities of the three sampling locations. In the autumn, winter and spring periods, the samples from the various areas do not show expressed differentiation; the time-point of sampling is determinant in the development of the groups. At all three sampling areas the highest values of diversity were experienced in the summer months. The diversity index values in the winter months at the time of the winter biomass maximums are due to the outstandingly high number of individuals of a few species. (Moore-IVI)
W85-03117

**EFFECTS OF ACIDIFICATION AND PHOSPHORUS ADDITION ON PHYTOPLANKTON BIOMASS AND PRODUCTIVITY IN A CIRCUM-NEUTRAL MESOTROPHIC LAKE RECEIVING ACID PRECIPITATION,**
West Virginia Univ., Morgantown.
K. E. Havens, III, and J. DeCosta.
Archiv fur Hydrobiologie, Suppl. 69, No. 4, p 443-476, October, 1984. 11 Fig, 19 Tab, 30 Ref.

Descriptors: *Water pollution effects, *Acid precipitation, *Lake O'Woods, *West Virginia, *Trophic level, Acidification, Phosphorus, Mesotrophic lakes, Phytoplankton, Biomass.

A one year study was performed in 1980 to determine the trophic status of Lake O'Woods, and assess the impact of acid precipitation on this shallow lake. In situ bag experiments were performed during 1980 and 1981 to examine the effects of acidification and phosphorus addition on algal biomass and productivity. Lake O'Woods is a small impoundment in northern West Virginia, mesotrophic based on chlorophyll a concentrations, annual primary production, and total phosphorus loading. While the lake receives large inputs of hydrogen ions via the precipitation, the lake maintains a circum-neutral pH because a large limestone formation in the watershed effectively buffers the incoming acid. This limestone formation is very large and therefore Lake O'Woods resistance to acidification should be a long term phenomenon. Phosphorus addition resulted in increased phytoplankton biomass and productivity, regardless of pH. Nitrogen became a secondarily limiting nutrient in bags where phosphorus addition resulted in rapid algal growth. With the exception of an initial period of pH shock immediately following acid addition, acidification did not cause reduced algal biomass, production, or production efficiency, despite the extreme nature of the acidification treatments used. The results lend further support for the idea that as a lake is acidified, levels of algal biomass and production will be determined by the phosphorus concentration in the lake. The increased acidity should not have any significant effect on algal biomass, production, or production efficiency, unless for some reason it results in a change in phosphorus availability. (Baker-IVI)
W85-03123

**FAUNISTIC INVESTIGATIONS OF THE HYPORHEIC INTERSTITIAL OF THE RIVER MUR (STYRIA, AUSTRIA) (FAUNISTISCHE UNTERSUCHUNGEN IM HYPORHEISCHEN INTERSTITIAL DES FLUSSES MUR (STEIERMARK, OSTERREICH)),**
Graz Univ. (Austria). Inst. fuer Zoologie.
M. Kirchengast.
International Revue de Gesamten Hydrobiologie, Vol. 69, No. 5, p 729-746, 1984. 6 Fig, 2 Tab, 42 Ref.

Descriptors: *River Mur, *Interstitial water, *Invertebrates, *Water pollution effects, *Austria, Population dynamics, Aquatic fauna.

Two distinct sections of the River Mur, Styria, Austria, one almost unpolluted and the other heavily polluted by domestic and industrial waste waters, were investigated for two years. Essential differences occur in the following ecological parameters. The maximal water temperature in summer is 11 C at Murau and 18 C at Granz. The oxygen concentration of the river water at Murau oscillates in the vicinity of 10.5 mg/l and never drops below 4.1 mg/l in the sediments. In the Graz area, however, the oxygen concentration of the running water fluctuates between 4.5 and 11.5 mg/l and decreases in the hyporheic interstitial zone to between 0.1 and 2.5 mg/l. The lack of sufficient oxygen is responsible for the absence of some species. Calcium lignosulfonic acids can be found only in the Graz area where they occur in large amounts. Sphaerotilus natans filaments cover the entire river bottom in the Graz region and reach a height of several centimeters. This sewage bacterium does not occur in the Murau area. The fauna of the clean section differs from that in the polluted region qualitatively, and even to a greater degree quantitatively. In the area upstream from Murau, chironomids were most numerous, followed in abundance by trichopterans, oligochaetes, nematodes and water mites. All other taxa together comprise barely 10% of the total invertebrate fauna of the Murauregion. In the Graz region, oligochaetes clearly form the predominant group, followed in abundance by chironomids and nematodes. All other taxa together contribute less than 1% to the total number of species. Water mites are completely absent. (Baker-IVI)
W85-03126

**TOXIC BLUE-GREEN ALGAL BLOOMS IN EUROPE: A GROWING PROBLEM,**
Norsk Inst. for Vannforskning, Oslo.
O. M. Skulberg, G. A. Codd, and W. W. Carmichael.
Ambio, Vol. 13, No. 4, p 244-247, 1984. 2 Fig, 2 Tab, 37 Ref.

Descriptors: *Algal growth, *Toxicity, *Europe, *Eutrophication, Saline water, Fresh water, Public health, Water pollution effects, Toxins, Toxicity.

Several species of blue-green algae in saline and freshwaters produce toxins which cause illness or death to domestic animals, birds and fish. Toxicity can vary in time and location within a given water body. Blooms and toxic blooms are often associated with man-induced eutrophication. Situations involving suspected toxic blue-green algae often result in incomplete documentation of the circumstances for the toxic oubreak. Administrators and officials in Europe are generally not well informed about the possible health hazards from toxic blue green algae. The interest and awareness of some scientists as regards toxic blue green algae are increasing. Several recent cases of toxicity have taken place in different parts of Northern Europe indicating that the problems of the toxic algae are more widespread than hitherto understood. New species of blue green algae with toxic properties have been discovered. Toxin producing populations of cyanophyceans have been detected in several geographical regions. Toxicity assays reveal a complex pattern of pathology indicating that toxicity can be chronic, acute or lethal. (Baker-IVI)
W85-03199

**ACIDIFICATION OF LAKES: EFFECTS ON WATERBIRDS IN SWEDEN,**
Goeteborg Univ. (Sweden). Dept. of Zoology.
M. O. G. Eriksson.
Ambio, Vol. 13, No.4, p 260-262, 1984. 2 Fig, 50 Ref.

Descriptors: *Water pollution effects, *Acidification, *Lakes, *Birds, *Sweden, Fish, Aquatic plants, Ducks, Aluminum, Metals, Population dynamics, Turbidity, Aquatic insects, Acid rain.

The ecological changes in lakes damaged by acidification affect waterbirds in many different ways according to the feeding habits of each species concerned. Ducks feeding on aquatic insects are favored by the reduced competition with fish for common prey. Goldeneye in particular exploit the increased populations of highly mobile insects which turn up in lakes with reduced densities of fish. Birds which eat fish are compensated for the decreasing numbers of fish by the increasing clarity of the water which makes the remaining fish easier to see. In addition to exposure to ecological changes resulting from acidification, birds are also increasingly exposed to metal pollutants, which increase in acidifed waters. Among passerine birds, impaired reproductive success has been related to breeding in territories close to the shore, where they are exposed to aluminum by feeding on emerging insects. Waterbird fauna is in general sparse along lakes susceptible to acidification, but for some species a considerable proportion of the total European populations breed at such waters and for them the situation is critical. (Baker-IVI)
W85-03200

**FRESHWATER ONCOLITES CREATED BY INDUSTRIAL POLLUTION, ONONDAGA LAKE, NEW YORK,**
Geological Survey, Lakewood, CO. Water Resources Div.
W. E. Dean, and J. R. Eggleston.

Sedimentary Geology, Vol. 40, No. 4, p 217-232, August, 1984. 10 Fig, 2 Tab, 10 Ref.

Descriptors: *Onondaga Lake, *New York, *Oncolites, *Water pollution effects, Calcium carbonate, Sodium, Chlorides, Bicarbonates, Cyanophyta, Charophytes, Lakes.

Onondaga Lake is a culturally eutrophic marl lake within the metropolitan area of Syracuse, New York. The lake is moderately saline with waters rich in calcium, sodium, chloride and bicarbonate. Large quantities of calcium carbonate that are precipitated in the lake result from excess calcium supplied as calcium chloride wastes produced by soda-ash manufacturing to lake waters that are at or near saturation with respect to calcium carbonate from solution of carbonate rocks in the drainage basin. Beaches along the leeward shore of the lake are composed almost entirely of oncolites ranging from a few millimeters to several centimeters in maximum dimension. Offshore, in 1-2 m of water, the oncolites are biscuit-shaped concretions as much as 15 cm in diameter. The oncolites consist mainly of low-magnesium calcite, but dissolution of the carbonate with dilute acid results in a mass of blue-green algal filaments of the same approximate size and shape as the original oncolite. Most oncolites have an obvious nucleus; the most common nucleus is the hollow stem and cortication tubules of charophytes. Charophytes do not occur in Onondaga Lake today although they are common in other limestone-bedrock lakes in central New York State. Charophytes probably were eliminated by the marked increases in salinity of the lake that resulted from the introduction of soda-ash manufacturing on the lake shores around 1880 which means that growth of the oncolites began at least 100 years ago. (Baker-IVI)
W85-03217

## 5D. Waste Treatment Processes

**DESTRUCTION BY OZONE OF AMOEBA CYSTS IN RECYCLED SWIMMING POOL WATER,**
Caen Univ. (France). Unit of Pharmaceutical Sciences.
D. Perrine, D. Barbier, P. Georges, and B. Langlais.
Effluent and Water Treatment Journal, Vol. 24, No. 8, p 299-303, August, 1984. 3 Tab, 18 Ref.

Descriptors: *Swimming pools, *Protozoa, *Amoeba, *Ozonation, Pathogenic protozoa, Disinfection, Water reuse, Naegleria, Acanthamoeba, Hartmannella, Public health, Water treatment.

Suspensions of cysts from cultures of eleven strains of free-living amoeba of the Naegleria, Acanthamoeba and Hartmannella genera likely to be encountered in swimming-pool water, some of which may be pathogenic to man, were subjected to ozonization in bactericidal and virucidal conditions. For Naegleria, the method was not appreciably more effective than halogen treatment. There was, however, a considerable improvement for Acanthamoeba and cysts of A. culberstoni, a pathogenic strain, which were resistant to chlorine, were quickly destroyed by ozonization. Similarly, cysts of A. polyphaga, which resisted 40 mg HOCl/liter for 60 minutes were largely destroyed by ozonization. The results show significant resistance of these cysts, but the original level of 9,200 cysts per liter was considerable, and much higher than that to be expected in a swimming pool, and the figure of 500 cysts per liter after ozonization is well below the 20000 per liter considered as the permissible maximum. Cysts of Hartmannella which are also among those commonly resistant to halogen treatment, were destroyed fairly easily by ozonization. (Baker-IVI)
W85-02725

**EVALUATION OF SINGLE- AND SEPARATED-PHASE ANAEROBIC INDUSTRIAL WASTEWATER TREATMENT IN FLUIDIZED BED REACTORS,**
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. A. Bull, R. M. Sterritt, and J. N. Lester.
Biotechnology and Bioengineering, Vol. 26, No. 9, p 1054-1065, September, 1984. 9 Fig, 8 Tab, 35 Ref.

Descriptors: *Fluidized beds, *Wastewater treatment, *Anaerobic digestion, Chemical oxygen demand, Industrial wastes, Acidification reactor.

Four fluidized bed reactors were used to evaluate single- and separate-phase anaerobic treatments of a high strength wastewater. Two reactors were fed with a synthetic wastewater, containing glucose as the primary carbon source, with a COD of 12000 mg/liter while the remaining pair were fed with a wastewater with a COD of 6000 mg/liter. At each influent strength, one fluidized bed reactor was operated as a single-phase system while the other was operated as a methanogenic reactor which was preceeded by an acidification reactor in a separated-phase system. The reactors were operated under steady-state and variable process conditions. Anaerobic fluidized bed reactors treating a glucose based substrate achieved good COD removal up to a COD loading of 15 kg/cu m/day. Above this loading, volatile acid accumulation indicated failure of the reactors. The addition of a stirred tank reactor to achieve a separated phase system with an acidification reactor followed by a methanogenic fluidized bed reactor improved effluent quality compared to a single-phase fluidized bed reactor. The separated-phase system produced an effluent with a considerably lower suspended solids concentration, and this was attributed to the superior settling properties of the acidification reactor sludge and the formation of ethanol and lactate in the acidification reactor which has been shown to reduce acid sludge production. Under shock load conditions, the separated-phase system was inherently more stable. In calculation of the kinetic parameters of acetate and propionate degradation, acetate degradation was 4.3 times greater and propionate degradation 9.9 times greater than values reported for a conventional anaerobic sludge digester. Specific degradation rates for acetate and propionate were 2.08 and 1.96 times higher, respectively, in a separated-phase system compared to the single-phase system. (Baker-IVI)
W85-02735

**MICROBIOLOGICAL EXAMINATION OF A TWO-STAGE WASTEWATER TREATMENT PLANT, 1. COMMUNICATION: QUALITATIVE AND QUANTITATIVE EXAMINATION OF AEROBIC AND FACULTATIVELY ANAEROBIC CHEMOHETEROTROPHIC BACTERIAL POPULATIONS (MIKROBIOLOGISCHE UNTERSUCHUNGEN EINER ZWEISTUFIGEN ADSORPTIONS-BELEBUNGSANLAGE, 1. MITTEILUNG: QUALITATIVE UND QUANTITATIVE ERFASSUNG DER AEROBEN UND FAKULTATIV ANAEROBEN CHEMOHETEROTROPHEN BAKTERIENPOPULATIONEN),**
Bonn Univ. (Germany, F.R.).
A. Wetzel, and W. Dott.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 4, p 121-126, August, 1984. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Activated sludge process, *Aeration, *Bacteria, Microorganisms, Sludge, Wastewater treatment facility.

Activated sludge samples, taken from both aeration tanks of a two-stage wastewater treament plant, were microbiologically examined. The number of viable bacteria was generally about an order of magnitude higher in stage A than in stage B. No significant differences were found between the two stages, however, when an analysis of the aerobic/facultatively anaerobic chemoheterotrophic bacteria flora was performed. Common bacterial groups included inert gram-negative rods, Enterobacteriaceae and pseudomonads. The sludges differ regarding the presence of protozoans, as higher organisms were found only in stage B. (Author's abstract)
W85-02737

**ANTIBACTERIAL EFFECTS ON PREDOMINANT TAXA IN THE ACTIVATED SLUDGE SYSTEM OF A CHEMICAL COMBINE (DIE HEMMSTOFFRESISTENZ DOMINIERENDER BAKTERIENGRUPPEN IN DER BELEBTSCHLAMMANLAGE EINES CHEMIEWERKS),**
Technische Univ. Muenchen, Weihenstephan (Germany, F.R.). Sueddeutsche Versuchs- und Forschungsanstalt fuer Milchwirtschaft.
H. Seiler, H. Blaim, and M. Busse.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17. No. 4, p 127-133, August, 1984. 1 Fig, 3 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Bacteria, *Purification, *Activated sludge process, Solvents, Sludge, Industrial wastes.

The sensitivity on selective media and the break point concentrations of bioinhibitory agents were tested for the prevalent bacterial groups of a wastewater treatment plant of the chemical industry. After a remarkable reduction in purification efficiency the strains of the dominant taxa comprised the most resistant bacteria. This confirms the assumption that the fall in process efficiency noted was caused by an intoxication of the activated sludge flora. The sensitivity of Cornyforms and other Gram-positive microorganisms enabled them to serve as indicator organisms for a low sludge load with poisonous effluents. Concepts to reduce the risk for sludge intoxication are discussed including the reduction of risk of sludge intoxication by operational control of the water treatment systems based on biological data. (Author's abstract)
W85-02738

**INVESTIGATION AND DEVELOPMENT OF SWIMMING POOL WATER TREATMENT, III. LONG CONTACT TIME OZONATION FOR POOL WATER TREATMENT (ERFORSCHUNG UND ENTWICKLUNG DER SCHWIMMBADWASSERAUFBEREITUNG. III. MITT: BADEWASSERAUFBEREITUNG MIT OZON IM LANGZEITKONTAKT),**
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
D. Eichelsdorfer, and J. Jandik.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 4, p 148-153, August, 1984. 9 Fig, 1 Tab, 12 Ref.

Descriptors: *Swimming pools, *Ozonation, *Water treatment, Ozone, Disinfection, Filtration, Flocculation, Chlorination, Reaction rate.

In the ozone pool water treatment process, contaminants are normally removed in a stepwise process. Sieving, flocculation and filtration steps are followed by ozonation. The toxic ozone is removed from the water by filtration through an activated carbon layer before the water is brought back into a swimming pool. This treatment is followed by chlorination for disinfection. In the ozone process described the time available for the reaction of the ozone is very short - usually 1.5 to 3 minutes. However, some of the reaction rates are rather slow and longer reaction times need to be provided. The efficiency of the ozonation process with longer reaction times followed by slower filtration has been proven in a research project. (Baker-IVI)
W85-02740

**EXPERIENCE WITH THE CO-DISPOSAL OF HAZARDOUS WASTE WITH DOMESTIC WASTE,**
London Brick Landfill Ltd., Stwartby (England).
For primary bibliographic entry see Field 5E.
W85-02752

**STRIPPING OF ORGANIC CHEMICALS IN BIOLOGICAL TREATMENT PROCESSES,**
IT Corp., Knoxville, TN.
K. N. Truong, and J. W. Blackburn.
Environmental Progress, Vol. 3, No. 3, p 143-152, August, 1984. 8 Fig, 8 Tab, 14 Ref. EPA contracts 68-03-3027 and 68-03-3074.

Descriptors: *Biological wastewater treatment, *Stripping, *Organic compounds, Volatilization,

Volatility, Industrial wastewater, Activated sludge process.

Wastewater treatment plants often receive volatile compounds in their influent from industrial discharges or from other sources. Stripping is distinguished from volatilization by the mode of gas-liquid contact. Stripping is the process of gas/liquid mass transfer in systems with dispersed gas or liquid phases. Volatilization occurs at the major surface between gas and liquid phases. Stripping processes normally have a much greater interfacial area and may often be more turbulent than volatilization processes. A method is presented which offers a simpler approach for estimating stripping rates in pure water and wastewater than other approaches based on the two film theory of mass transfer. The presence of surfactants, salts, oils, and nonviable biomass was found to vary the stripping rate, but in no case was the effect more than 30% when compared with pure water. The values of the stripping rate constant predicted from the model in the study seem to agree reasonably well with previously reported values. The stripping predictive fate method was tested in continuous large scale activated sludge units. (Baker-IVI)
W85-02767

**PREDICTIVE ASSESSMENT OF PRIORITY POLLUTANT BIO-OXIDATION KINETICS IN ACTIVATED SLUDGE,**
Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, A. Breen, J. W. Blackburn, and O. Yagi.
Environmental Progress, Vol. 3, No. 3, p 153-163, August, 1984. 11 Fig, 9 Tab, 14 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Biooxidation, Chemical reactions, Bacteria, Organic compounds, Biological wastewater treatment, Phenols, Mineralization, Toluene.

Bacterial population densities and enzyme activities were measured in activated sludge to serve as predictive tools for assessing biooxidation of organic pollutants. Batch sludge cultivation using fill-and-draw reactors was performed to establish acclimated sludge used in developing the biooxidation assay and to determine the biooxidative response of the sludge during acclimation to test pollutant substrates. An overall summary of the rate constants for the substrates is given. There was less than a two fold difference in the maximum attained first order rate constant for phenol mineralization in either batch or continuous sludge cultures. This relationship also holds true for toluene mineralization in the same comparison. A like relationship is observed for the mean first order rate constants for the two substrates in the different sludge cultures. These results indicate the quantitative role of developing bacterial populations during acclimation and can be reflected in second order mineralization rate constants. On a comparative basis, phenol removal rates are an order of magnitude faster than mineralization of the substrate to carbon dioxide. The results of this study indicate that potential may exist for predicting biooxidation mineralization kinetics based on observed population and enzyme population. (Baker-IVI)
W85-02768

**IN-SITU AND ON-SITE BIODEGRADATION OF INDUSTRIAL LANDFILL LEACHATE,**
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
D. S. Kosson, and R. C. Ahlert.
Environmental Progress, Vol. 3, No. 3, p 176-183, August, 1984. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Leachates, *Landfills, *Industrial wastes, Wastewater treatment, Biodegradation, Hazardous wastes.

Industrial landfill leachates are similar to very high strength, complex industrial wastewaters. An on site field, pilot scale experiment was performed which demonstrated promising results for the treatment of aqueous hazardous wastes. Pretreatment was needed to remove bulk and dispersed organic phases. Seeding and acclimation of a mixed microbial population was sufficient to achieve an active in-situ microbial community. A sandy loam and a clay loam with different permeabilities and sorptive characteristics have been investigated. TOC reductions in excess of 90% were readily achieved and reductions in excess of 95% have been observed. (Baker-IVI)
W85-02769

**COMPETITIVE ADSORPTION OF PHENOLS ON ACTIVATED CARBON,**
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
C. Yen, and P. C. Singer.
Journal of Environmental Engineering, Vol. 110, No. 5, p 976-989, October, 1984. 4 Fig, 5 Tab, 18 Ref. EPA grant R804917.

Descriptors: *Phenols, *Adsorption, *Activated carbon, *Langmuir model, *Ideal Adsorbed Solution theory, Model studies, Adsorbents, Water treatment, Wastewater treatment, Organic compounds.

The adsorption of phenol and substituted phenols on activated carbon was examined. An improved calculation procedure for the Ideal Adsorbed Solution (IAS) model was developed to describe adsorption in multi-component systems. This method is more accurate and more effective than the original published method and, most importantly, makes the IAS model predictive in nature. Using this modified calculation method, the IAS model was proved to be superior to the Langmuir competitive model in predicting multi-component adsorptive behavior in several phenolic mixtures. These included binary and ternary systems, systems containing similar and dissimilar components, and mixtures containing different initial concentrations of the solutes. The IAS model was found to be especially better than the Langmuir competitive model in predicting the concentration of minor components in systems containing species with different initial concentrations. The modified three-parameter Freundlich model was shown to effectively describe single-solute adsorption, and was proven to be useful in predicting multi-component adsorptive behavior because of its computational efficiency in the IAS model. (Baker-IVI)
W85-02820

**SEASONAL VARIATIONS OF PHOSPHATE SPECIES IN WASTEWATER,**
Sherbrooke Univ. (Quebec). Dept. of Civil Engineering.
K. S. Narasiah, and C. Morasse.
Journal of Environmental Engineering, Vol. 11, No. 5, p 1005-1008, October, 1984. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Phosphates, *Wastewater analysis, *Seasonal variation, Pollutant identification, Orthophosphates, Effluents, Wastewater treatment.

On-site and lab experiments were conducted on an existing biological wastewater treatment plant during winter and summer. Correlations between the phosphate fraction showed that orthophosphate in effluent constituted a greater proportion of total phosphorus during summer months than winter months. This difference may be due to more extensive hydrolysis of polyphosphates in the wastewater during summer than winter. The defined relationships between total orthophosphate (TOP) and total phosphate (TP) could be useful in the day-to-day operation of a wastewater treatment plant as they point out the change of these relationships from summer to winter months. Plant operators who utilize a TOP measurement to characterize effluent TP would be well advised to determine the values of phosphorus species due to seasonal changes. By measuring orthophosphates in the effluent, which is fairly direct and uncomplicated, one can calculate the total P in the effluent. (Baker-IVI)
W85-02823

**ESTIMATING CROP GROWTH RATE WITH LAND TREATMENT,**
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman.
Journal of Environmental Engineering, Vol. 110, No. 5, p 1009-1012, October, 1984. 3 Fig, 6 Ref.

Descriptors: *Plant growth, *Crop yield, *Land disposal, Wastewater irrigation, Bermudagrass, Water reuse, Grasses.

Data from the literature has been used to estimate growth rate of coastal bermudagrass as affected by harvest frequency and wastewater irrigation. Growth data was shown to follow the Gaussian probability function with a correlation coeffiecint of 0.9924. Irrigation and harvest frequency were shown to influence total yield, but not the shape of the growth curve. Assuming an average nutrient concentration of the grass, it is possible to calculate weekly uptake of nutrients. (Baker-IVI)
W85-02824

**WASTE WATER TREATING PROCESS,**
Chevron Research Co., Richmond, CA.
J. P. Leonard, N. J. Haritatos, and D. V. Law.
Chemical Engineering Progress, Vol. 80, No. 10, p 57-60, October, 1984. 3 Fig, 3 Tab, 1 Ref.

Descriptors: *Waste water treatment, *Economic aspects, *Oil refineries, *Hydrogen sulfide, *Ammonia, Water reuse, Industrial wastes, Oil industry.

The Chevron Waste Water Treating Process (WWT) is an economical method of treating sour water which produces high quality hydrogen sulfide suitable for feeding a sulfur recovery unit, anhydrous ammonia suitable for sale and stripped water suitable for reuse or discharge. The WWT process considered consists of four main processing steps: degassing and feed storage, acid gas stripping, ammonia stripping, ammonia purification and liquefaction. The WWT process is flexible and versatile. The two major reasons for building a WWT instead of a SWS followed by an ammonia-burning SRU are the economics of ammonia recovery and improved SRU operation. The economics of the WWT process strongly depend on the amount of ammonia present in the feed. The more ammonia in the sour water, the more incentive there is to recover it as a valuable by-product. Separation of ammonia from the hydrogen sulfide in the WWT has the following advantages for the SRU: elimination of ammonia-related problems in SRU's such as lower operating factor, plugging in condensers and seals caused by ammonia salts, and catalyst deactivation; increased overall sulfur recoveries; and reduction in the size of SRU's and tail gas units because ammonia and the air needed to burn it act as diluents. As an example, consideration is given to a refinery SRU that gets 70% of its acid gas feed from an amine plant with the rest coming from a sour water stripper. The gas from the sour water stripper contains 24 metric ton/d of ammonia. Removing the ammonia from the SRU reduces the SRU feed and combustion air flow rates by about 45%, thus reducing the size and cost of the SRU. The tail gas flow rate from the SRU is reduced by about 55%. Removing the ammonia diluent from the SRU can also increase the sulfur recovery by as much as 2%. (Baker-IVI)
W85-02863

**ACTIVATED CHARCOAL AND MICROFLORA IN WATER TREATMENT,**
Katholieke Univ. Leuven (Belgium). School of Public Health.
P. J. Van Dijck, and H. van de Voorde.
Water Research, Vol. 18, No. 11, p 1361-1364, 1984. 4 Tab, 11 Ref.

Descriptors: *Activated carbon, *Bacteria, *Water treatment, Disinfection, Wastewater treatment, Adsorption, Adsorbents, Microorganisms, Candida, Vahlkampfia, Leptospira, Trichomonas.

Significant sanitation was achieved by using 0.5% activated charcoal in influent and effluent of a wastewater treatment plant. The drastic reduction in the microorganisms was confirmed for twelve tester strains, including gram-positives, gram-nega-

tives, Candida albicans, Vahlkampfia avara, Leptospira biflexa and Trichomonas foetus. The removal of microflora correlates positively with the quality of the activated charcoal used. Once adsorbed, the bacteria could not be eluted by salt, alkalinization or citric acid. Diatomaceous earth also eliminated some of the microflora, but white clay (Bolus alba) and zinc dust are inefficient. The activated carbon may be reused several times after regeneration by heat (2 h at 160 C), but eventually a slight decrease in adsorbing capacity occurs. (Author's abstract)
W85-02907

**EQUALIZATION/NEUTRALIZATION MODELING AN APPLICATION TO FLUORIDE REMOVAL,**
Texas Univ. at Austin. Dept. of Civil Engineering.
D. F. Lawler, and D. H. Williams.
Water Research, Vol. 18, No. 11, p 1411-1419, 1984. 13 Fig, 2 Tab, 10 Ref.

Descriptors: *Fluoride, *Aluminum refining, *Wastewater treatment, *Model studies, *Equalization, *Normalization, Hydrogen fluoride, Hydrogen ion concentration, Lime, Carbonates, Chemical precipitation, Scrubbers.

Hydrogen fluoride gas (HF(g)) is produced in the reduction of aluminum ore through the use of cryolite, Na3AlF6. The HF(g) is often removed from the waste gas stream by wet scrubbing, thereby transferring the fluoride into water as hydrofluoric acid. The scrubber wastewater is then treated with lime, Ca(OH)2, resulting in the precipitation of CaF2. For the capture of the fluoride in the scrubbers and removal via precipitation and sedimentation, plant operators attempt to maintain the pH in the water going to the scrubbers in the narrow range of $8.0 < pH < 8.3$. Carbonate, when present in the system studied, was found to interfere with the precipitation in the pH range 7-11 but little carbonate was in the system studied because of the low pH and high gas/liquid exchange in the scrubber. A general approach to modeling equalization/neutralization problems was developed using mass balances on conservative substances and a charge balance to determine pH. The precipitation of CaF2 in the pH range 6-11 is strongly dependent on pH only when carbonate is present. Due to the capture of the HF, the pH of the effluent of the scrubber is inevitably low; the low pH leads to the virtual absence of carbonate in the water, which in turn leads to the difficulty of controlling the pH in the range 6-10. (Collier-IVI)
W85-02914

**KINETICS OF MICROBIAL INACTIVATION BY CHLORINE - I; REVIEW OF RESULTS IN DEMAND-FREE SYSTEMS,**
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and S. B. Karra.
Water Research, Vol. 18, No. 11, p 1443-1449, 1984. 4 Tab, 29 Ref.

Descriptors: *Kinetics, *Chlorine, *Microbiological studies, *Disinfectants, Water treatment, Chloramine, Model studies, Chlorination.

Available data on microbial inactivation by free and combined chlorine were analyzed under demand-free conditions using several different kinetic models. The Chick-Watson model produced an adequate fit and, in general, no substantial improvement in the fit to experimental data is obtained by using the alternative models. The relative kinetics of inactivation by free vs combined chlorine have been compared to the available information on the equilibrium between free and combined chlorine species, and this comparison suggests that the combined chlorine species themselves, rather than merely the equilibrium free chlorine present, may possess some biocidal activity. The propagated measurement errors have been estimated, and based on this, in most cases, the residuals from the Chick-Watson estimation equation are greater than the measurement error, and therefore potential for improvement in the understanding of disinfection kinetics exists. (Baker-IVI)
W85-02917

**KINETICS OF MICROBIAL INACTIVATION BY CHLORINE - II; KINETICS IN THE PRESENCE OF CHLORINE DEMAND,**
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and S. B. Karra.
Water Research, Vol. 18, No. 11, p 1451-1454, 1984. 5 Tab, 11 Ref.

Descriptors: *Kinetics, *Coliforms, *Wastewater, *Disinfection, *Model studies, *Chlorine, Water treatment, Chlorination, Bacteria, Hydraulic properties.

Use of the empirical Selleck model for description and analysis of kinetics of coliform decay in wastewater and other systems containing chlorine demand, has been shown to be justifiable as an approximation to rational kinetic behavior. More importantly, it suggests that the dominant features of wastewater chlorine disinfection may be predicted from and are consistent with the results obtained in demand-free systems. The sensitivity analyses conducted indicate that the Selleck parameters depend most strongly upon the inactivation rates of microorganisms which could be determined in demand-free systems. By additional knowledge of the immediate chlorine demand, and of the rate of conversion of free to combined chlorine it is possible to provide a good estimate of specific parameters which may then be used for design purposes. The efficiency of disinfection in real wastewater chlorine contact chambers is influenced by the hydraulic performance of the contact chambers. By application of the reaction rates estimated by use of the rational model is should be possible to estimate quantitatively the degree of influence on such hydraulic factors. This would provide a rigorous test of the validity of the kinetic model discussed. (Baker-II)
W85-02918

**ACUTE TOXICITY OF CHROME ELECTROPLATING WASTES TO MICROORGANISMS: ADSORPTION OF CHROMATE AND CHROMIUM (VI) ON A MIXTURE OF CLAY AND SAND,**
Aligarh Muslim Univ. (India). Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W85-02921

**DYNAMICS OF POLLUTION-INDICATOR AND HETEROTROPHIC BACTERIA IN SEWAGE TREATMENT LAGOONS,**
Montreal Univ. (Quebec). Dept. of Biological Sciences.
P. Legendre, B. Baleux, and M. Trousselier.
Applied and Environmental Microbiology, Vol. 48, No. 3, p 586-593, September, 1984. 5 Fig, 1 Tab, 25 Ref. Natural Sciences and Engineering Research Council Canada grant A7738.

Descriptors: *Bioindicators, *Heterotrophic bacteria, *Wastewater treatment, *Lagoons, Phytoplankton, Zooplankton, Bacterial analysis.

The spatio-temporal dynamics of pollution-indicator bacteria and aerobic heterotrophic bacteria were studied in the sewage treatment lagoons of an urban wastewater center after 26 months of biweekly sampling at eight stations in these lagoons. Robust statistical methods of time-series analysis were used to study successional steps (through chronological clustering) and rhythmic behavior through time (through contingency periodogram). The aerobic heterotrophic bacterial community showed two types of temporal evolution: in the first four stations, it seems mainly controlled by the nutrient support capacity of the sewage input, whereas in the remaining part of the lagoon, it seems likely that the pollution-indicator bacteria are gradually replaced by other bacterial types that are better adapted to this environment. On the other hand, the pollution-indicator bacteria showed an annual cycle which increased in amplitude at distances further from the wastewater source. The main events in this cycle were produced simultaneously at all stations, indicating control of these bacterial populations by climatic factors, which act through physical and chemical factors, and also through other biological components of this ecosystem (phytoplankton and zooplankton). Results from this study suggest a modified design for a future study program. (Author's abstract)
W85-02935

**SUPPORT BIOLOGIES IN WASTE WATER TECHNOLOGY (TRAGERBIOLOGIEN IN DER ABWASSERTECHNIK),**
Krupp (Fried.) G.m.b.H., Essen (Germany, F.R.).
C. Oehme.
Chemie Ingenieur Technik, Vol. 56, No. 8, p 599-609, August, 1984. 14 Fig, 5 Tab, 104 Ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Activated carbon, Biodegradation, Biomass, Contact beds.

The numerous possibilities of immobilizing biomass and using it fixed on a wide range of carriers in the available types of reactors is matched by a great variety of practical applications in waste water purification technology for partial, complete, subsequent, and ultrapurification. All support biologies share the following advantages to a greater or lesser extent: smaller reactor volumes and shorter reaction times thanks to higher biomass concentrations; volume reduction or elimination of subsequent purification pools owing to the more favorable sludge index and fixation in the reactor or the filter; long sludge lifetimes are possible (favorable for slowly multiplying nitrifiers and specialist strains); no floating sludge formation on carbohydrate degradation or nitrification; and increase in process stability and degradation activity towards refractory compounds which are difficult to degrade biologically if suitable supports showing synergistic activity are used, such as highly porous activated charcoal. (Author's abstract)
W85-02958

**HIGH-BOD LOADING TREATMENT USING LARGE-SCALE DEEP AERATION TANKS,**
Hitachi Research Lab. (Japan).
N. Shimizu, T. Sumitani, Y. Masaki, Y. Odawara, and S. Hisatomi.
Journal of Fermentation Technology, Vol. 62, No. 3, p 277-284, 1984. 11 Fig, 2 Tab, 9 Ref.

Descriptors: *Food-processing wastes, *Deep aeration tanks, *Activated sludge process, Wastewater treatment, Aeration, Biochemical oxygen demand, Oxygen transfer.

The rising cost of land and the smaller areas available for construction of wastewater treatment plants have stimulated increased interest in deep aeration tanks for activated sludge process wastewater treatment. A large-scale aeration process was investigated with one deep aeration tank 5 m in diameter and three deep aeration tanks 8.7 m in diameter, all of which were capable of treating wastewater at high levels of BOD loading. Beanpaste wastewater treatment was carried out in the 5 m diameter aeration tank with a a liquid height of 9 m. The BOD removal rate ranged from 92 to 99%. The sludge volume index (SVI) values ranged from 180 to 320 mg/l. The oxygen transfer rate is directly proportional to BOD loading. The size of deep aeration tanks used in the activated sludge process can be increased if the oxygen transfer rate is used as a parameter. Beet sugar wastewater with a feed rate of 6,000 cu m/day was treated in three 8.7 m diameter tanks, each of which had a liquid height of 9 m. The BOD removal rate ranged from 98 to 99% the SVI values of the activated sludge ranged from 127 to 148 ml/g. The power required was only 0.56 kWh/hg-BOD removed. Very high-BOD wastewater can be efficiently treated with deep aeration tanks. (Moore-IVI)
W85-02972

**WATER AUTHORITY VIEW OF TRADE EFFLUENT CONTROL,**
M. D. Colley.

Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 4, p 297-304, October, 1984. 1 Tab, 8 Ref.

Descriptors: *Industrial wastewater, *Northumbrian Water Authority, *England, Water pollution control, Spills, Sewer systems, Wastewater facilities, Sampling.

Within a national framework, agreed between the Confederation of British Industry (CBI) and the water industry, a generally uniform system of industrial (trade) effluent control and charging has developed, though some differences of approach remain between water authorities. The Northumbrian Water Authority (NWA) is one of the smaller authorities, serving a population of about 2.6 million. The trade effluent and river quality functions were combined in 1980 into a Pollution Prevention Department. Only a small proportion of industrial effluent discharges to sewers cause problems of a continuous nature. Short-term unsatisfactory discharges are more common and prove more troublesome because of their unexpected nature, and the disruptive effect they have on sewerage and sewage disposal operations. Close liaison between water authorities and developers at the early planning stage can help to avoid many of the causes of sewerage and sewage disposal incidents, especially those caused by leaks and spillages. Efforts are being made to reduce costs by reducing sampling programs, while retaining adequate control of discharges and securing sufficient data to levy fair charges. (Moore-IVI)
W85-03017

**TRADE EFFLUENT CONTROL - AN INDUSTRIAL VIEWPOINT,**
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
L. R. Reynolds, and B. R. H. Williams.
Journal of Institution of Water Engineers and Scientists, Vol. 38, No. 4, p 305-315, August, 1984. 5 Tab, 20 Ref.

Descriptors: *Industrial wastewater, *Legislation, *United Kingdom, European Economic Community, Water quality, Water pollution control, Cost analysis.

During the past few decades there has been a progressive extension in legislative control over sewage and trade effluent discharges. While inevitably leading to increased public and industrial expenditure, in the United Kingdom (UK) it has also resulted in a steady and noticeable improvement in the quality of natural receiving waters. Overall this implementation of extended legislation can be said to have been cost-effective. New legislative controls proposed in EEC (European Economic Community) Directives and in UK law appear to be more extensive than hitherto, and if implemented without due consideration of the balance between scientific assessment, cost effectiveness and ultimate aims, will result in significant cost increases to industry, water authorities and public alike, without a genuine and worthwhile environmental benefit. (Moore-IVI)
W85-03018

**BEHAVIOUR OF PERSISTENT ORGANOCHLORINE MICROPOLLUTANTS DURING PRIMARY SEDIMENTATION OF WASTE WATER,**
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. G. Gutierrez, A. E. McIntyre, R. Perry, and J. N. Lester.
Science of the Total Environment, Vol. 39, No. 1/2, p 27-47, October, 1984. 2 Fig, 10 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Sedimentation, *Organic pesticides, Insecticides, Aldrin, Endrin, Dieldrin, gamma-HCH, Polychlorinated biphenyls, Pilot plants, Water reuse, Water quality.

The behavior of polychlorinated biphenyls (PCB) and organochlorine insecticides (OCL), gamma-HCH, aldrin, dieldrin, and endrin during primary sedimentation of raw sewage containing varying concentrations of suspended solids, surfactants, and grease was investigated using jar test experiments. The effect of varying hydraulic and influent raw sewage suspended solids loadings on the removal of PCB and OCL during primary sedimentation were investigated using a pilot scale sedimentation tank. Significant removals of micropollutants into the primary sludge were noted. During the course of primary sedimentation, acceptable removals of suspended solids from the raw sewage influent were achieved and it was apparent that the sedimentation tanks were performing satisfactorily. The removals of PCB ad OCL during primary sedimentation were variable, although broadly within the range of those reported from previous studies. Where sewage effluents are discharged to rivers which are abstraction sources factors such as hydraulic dilution and natural adsorption and degradation processes in the water course may attenuate concentrations of organic contaminants such that conventional treatment at a subsequent abstraction point will produce potable water of an acceptable quality. If potable water of sufficient quality was not consistently produced, it may be debateable whether to upgrade water or waste water treatment processes. (Baker-IVI)
W85-03031

**ENHANCED ACTIVATED SLUDGE WASTE TREATMENT BY THE ADDITION OF ADSORBENTS,**
Kuwait Univ., Safat. Dept. of Civil Engineering.
M. F. Hamoda, and M. A. Fahim.
Environmental Pollution (Series A), Vol. 36, No. 3, p 283-294, 1984. 7 Fig, 1 Tab, 9 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Adsorbents, *Charcoal, *Kaolin, Sludge, Organic compounds.

Laboratory batch and continuous-flow experiments were conducted at 20 degrees C on primary treated wastewater using charcoal and kaolin in concentrations between 0 and 5000 mg/liter added to activated sludge bioreactors. Organic removal in the activated sludge system was enhanced by the addition of charcoal or kaolin, but the latter was relatively less effective. Removal efficiency increased with sorbent concentration to an optimum dosage of about 2000 mg/liter. Kinetic relationships obtained can be approximated by a first order reaction in which an apparent rate constant describes the overall substrate removal. Addition of sorbent generally improves sludge settleability and increases solids retention in the activated sludge system. Sorbent enhancement of organic removal could be attributed to concurrent adsorption and stimulation of biological activity. (Baker-IVI)
W85-03049

**EXPERIMENTAL STUDY OF OZONATION FOLLOWED BY SLOW SAND FILTRATION FOR THE REMOVAL OF HUMIC COLOUR FROM WATER,**
Queen's Univ., Belfast (Northern Ireland).
M. H. Gould, D. A. Cameron, and T. F. Zabel.
Ozone: Science and Engineering, Vol. 6, No. 1, p 3-15, 1984. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Ozonation, *Water treatment, *Color removal, *Northern Ireland, Humic substances, Filtration, Sand filters, Turbidity, Iron.

A pilot plant operation undertaken in Northern Ireland to investigate the use of ozonation followed by slow sand filtration for the removal of humic color from an upland water is described. Eleven separate test runs were undertaken using a number of process combinations and a range of ozone dosages. An ozone dose of 5 mg/l was required to reduce the color from 40 Hazen to less than 20 Hazen. At least for this source water, pre-ozonation generally reduced the filter run length of the slow sand filter. Pre-ozonation had little influence on the turbidity and iron concentration in the final water. Turbidities in excess of 1 NTU and iron concentration above 0.1 mg/l were frequently found in the effluent. Very good treated water quality was achieved with pre-ozonation followed by rapid gravity filtration and also sand filtration. Turbidities and iron concentrations were consistently reduced to below 0.3 NTU and 0.02 mg/l respectively and the filter run length was extended to more than 80 days. (Baker-IVI)
W85-03050

**TRADEOFFS IN WATER QUALITY MANAGEMENT,**
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. W. Male, and H. Ogawa.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 434-444, October, 1984. 6 Fig, 8 Ref. OWRT project A-115-MASS.

Descriptors: *Water quality management, *Decision making, *Ware River, *Massachusetts, Economic aspects, Low flow, Wastewater treatment, Biochemical oxygen demand, Dissolved oxygen.

A diagram was developed which can be used to assess easily some of the trade-offs involved in water quality management decisions. The diagram incorporates wastewater treatment costs, effluent quality, receiving stream water quality and different critical streamflows. The procedure was developed using biochemical oxygen demand as the discharge to be regulated and dissolved oxygen as the water quality parameter of interest. The use of the procedure is demonstrated for the Ware River in Massachusetts, where a primary treatment plant is being upgraded to meet water quality standards. The diagram is used to address the economic effect of specifying a critical low flow, other than the seven-day ten-year low flow. For the case study chosen, significant cost savings could result without substantially reducing the water quality of the receiving stream. (Moore-IVI)
W85-03063

**EFFLUENT IRRIGATION OF PARA GRASS: WATER, NITROGEN, AND BIOMASS BUDGETS,**
Florida International Univ., Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 3C.
W85-03132

## 5E. Ultimate Disposal Of Wastes

**ENVIRONMENTAL ENGINEERING AND PUBLIC HEALTH ASPECTS OF ALTERNATE DAIRY WASTE MANAGEMENT TECHNIQUES DESIGNED TO PROTECT GROUND WATER QUALITY,**
California State Coll., San Bernardino. Dept. of Health Science and Human Ecology.
A. El-Ahraf, W. Van Willis, F. Moses, and L. Mowafy.
Journal of Environmental Health, Vol. 47, No. 1, p 15-19, July-August, 1984. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Public health, *Metals, *Waste management, *Animal wastes, *Soil amendments, Feeds, Refeeding, Heavy metals, Water pollution control, Iron, Manganese, Lead, Zinc, Copper, Nickel, Cadmium, Environmental effects.

Environmental engineering and public health aspects of refeeding as an alternate diary waste management technique for the protection of ground water quality are described. A technique has been developed to process dairy manure into three fractions: CI or sillage; CII, a protein rich fraction; and CIII, a soil amendment. CI and CII are being fed to cattle and poultry on an experimental basis. The mean concentrations for Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn are reported as obtained from the analysis of the CI and CII fractions intended for use as animal feed. Levels of lead and cadmium in both CI and CII samples were lower than California's standards. There are no California standards for the other metals. Results indicate that protein products derived from the process do not contain sufficient concentrations of detected metals to warrant prohibiting their use as feed ingredients for poultry or cattle at this time. Based on metal levels obtained and the volume of manure produced, removal of the dairy waste from the Chino Basin would result in reduction of both soil contamination and the potential of water pollution by metals

at the following annual rates: 10,000 lbs of iron, 287 lbs of manganese, 232 lbs of zinc, 55 lbs of copper, 14 lbs of nickel, 4 lbs of lead, and 1.5 lbs of cadmium. Because of its higher fiber content, CI is also being considered as an energy source for dairy manure processing plants. (Baker-IVI)
W85-02724

**EFFECTS OF PH ON THE RELEASE TO SOLUTION OF ZINC, COPPER AND NICKEL FROM METAL-LOADED SEWAGE SLUDGES,**
Rothamsted Experiment Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 5B.
W85-02742

**EXPERIENCE WITH THE CO-DISPOSAL OF HAZARDOUS WASTE WITH DOMESTIC WASTE,**
London Brick Landfill Ltd., Stwartby (England).
A. C. Cheyney.
Chemistry and Industry, No. 17, p 609-615, September 3, 1984. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Waste disposal, *Hazardous materials, *Domestic wastes, *Co-disposal, Landfills, Leachates.

The co-disposal of hazardous and non-hazardous wastes is carried out in L Field, Stewartby, England. L Field is a pit created during the excavation of clay for brickmaking. The first refuse was deposited in L Field in November 1976. The great preponderance of solid wastes entering the site is domestic in origin. Surface water is pumped away, while the leachate which collects at the toe of the refuse is pumped back into trenches dug into the refuse. Liquid waste is disposed of in other trenches. The landfill mass is used as a giant anaerobic digestor. The liquid removed when the landfill is loaded hydraulically is treated by the use of a clay incline plane. Landfill gas is collected for use. (Baker-IVI)
W85-02752

**MANAGING ORGANICS IN SLUDGE REUSE PROGRAMS,**
Madison Metropolitan Sewerage District, WI.
D. Taylor.
BioCycle, Vol. 25, No. 6, p 20-22, September, 1984. 2 Tab, 12 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Organic compounds, *Regulations, Decision making, Planning, Management, Water pollution control.

As regulatory attention shifts to the organics in land application programs, it becomes essential that the proper approach is taken. Concentration specific regulations do not adequately protect human/animal health or environmental quality. In addition, they could preclude an opportunity to reuse sludges and use the treatment capability of the soil to degrade certain undesirable organics. The use of loading limits or maximum soil concentrations represents the most environmentally sound method of regulating organics in the land application program. The total mass loading to the environment for each site is then controlled, thereby minimizing the potential for groundwater contamination, plant accumulation, volatilization loss, and most importantly, introduction of organics to the food chain. (Baker-IVI)
W85-02796

**SALINITY AND ALFALFA YIELD UNDER EFFLUENT IRRIGATION IN SOUTHWESTERN SASKATCHEWAN,**
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
For primary bibliographic entry see Field 3C.
W85-02802

**COMPARING SOIL TESTS FOR A FORESTED ACID SANDY SOIL TOPDRESSED WITH SEWAGE EFFUENT,**
Florida Univ., Gainesville.
J. G. A. Fiskell, R. Rebertus, N. B. Comerford, and W. L. Pritchett.
Soil Science Society of America Journal, Vol. 48, No. 5, p 1170-1174, September/October 1984. 5 Tab, 19 Ref.

Descriptors: *Forest soils, *Wastewater disposal, *Land disposal, *Acidic soils, *Soil tests, Forests, Chemical analysis, Heavy metals, Nutrients, Fennel, Nitrogen, Phosphorus.

Mobility of nutrients and heavy metals from mineralization of sewage sludge in acid soils is an environmental concern. Chemical properties of a forested acid sandy soil on flat terrain were examined at 6 and 30 months after ceasing multiple spray applications of sewage effluent. Total dry sludge applied was 5 and 26 Mg/ha on the treated 3- by 15-m portion of 9- by 15 m plots. Less than 1.1 mg/L of either NO3(-)-N or PO4(3-)-P was found at the 24- to 90- cm depth in soil solution extracted from the untreated bed adjacent to the planting area during 144 days. Treated areas were sharply defined by the growth of indigenous dog fennel (Eupatorium sp.) which was the dominant species. Mean soil pH was below 4.7 to 6 months and 5.1 at 30 months. Treated interbed Cd, Cu, and NH4(+)-N were higher with depth at 30 months than 6 months while the reverse held for PO4(3-)-P. Untreated bed or interbed soils had lower soil test values than corresponding treated soils. Much higher metal values were found at the 7-cm depth than deeper. Differences in metal extracted from treated and untreated soils were readily distinguished by DA (Mehlich I), DTPA-TEA, and EDTA-AA soil test methods. All three methods extracted from 25 to 75% of the metals applied in the sludge. Lack of more downward movement of N, P, and metals was attributed to slow mineralization of the sewage sludge. (Author's abstract)
W85-02878

**EFFECT OF THERMAL PRETREATMENT ON THE ANAEROBIC BIODEGRADABILITY AND TOXICITY OF WASTE ACTIVATED SLUDGE,**
Imperial Coll. of Science and Technology, London (England). Dept. of Chemical Engineering and Chemical Technology.
D. C. Stuckey, and P. L. McCarty.
Water Research, Vol. 18, No. 11, p 1343-1353, 1984. 8 Tab, 22 Ref.

Descriptors: *Activated sludge, *Biodegradation, *Toxicity, *Thermal pretreatment, *Anaerobic digestion, Digestion, Pretreatment, Organic compounds, Sludge, Wastewater treatment, Biological wastewater treatment.

The management of sludges generated by biological treatment of wastewaters has become an increasingly severe problem in recent years. The objective of this study was to examine the effect of thermochemical pretreatment on the anaerobic biodegradability and toxicity of waste activated sludge (WAS). In order to accomplish this, the degradability and toxicity of pure nitrogenous organic compounds present in WAS, and mixtures of these compounds were also evaluated. The anaerobic bioconvertibility and toxicity of the various organics were determined using batch bioassay techniques. It was found that WAS bioconvertibility increased with increasing pretreatment temperature up to a maxium at 175 degreees, and this resulted in an increase in methane production of 27% over the control. With the compounds and cultures used, mesophilic bioconvertibility and toxicity were found to be significantly higher than the corresponding values under thermophilic conditions. Finally, it was found that most of the pure individual nitrogen compounds and simple mixtures tested were quite biodegradable, although at the concentrations evaluated (20 g/l) most were toxic. It was also noted that small changes in structure could have a significant effect on both toxicity and bioconvertibility. In most cases thermochemical pretreatment of these individual compounds resulted in decreased bioconvertibility and increased toxicity. In conclusion it can be stated that thermochemical pretreatment enhances WAS bioconvertibility, while under identical treatment conditions, resulted in a considerable reduction in bioconvertibility of individual nitrogen compounds and mixtures. This effect appears to be due to the conversion of biodegradable organics to refractory ones. Further, the toxicity of WAS after thermochemical pretreatment appears to be due to its solubilization, and conversion of these soluble products to toxic compounds under more extreme treatment conditions. (Author's abstract)
W85-02905

**SLUDGE DEWATERING AND COMPOST ECONOMICS,**
E. Epstein, and J. E. Alpert.
Biocycle, Vol. 25, No. 7, p 32-33, October, 1984. 2 Fig, 4 Tab, 3 Ref.

Descriptors: *Sludge drying, *Composting, *Economic aspects, Costs, Sludge disposal, Bulking agents.

The dewatering of sewage sludge can greatly affect the cost of composting. Proper dewatering resulting in high sludge solids will reduce capital costs and operation and management costs. The higher the sludge solids content, the less bulking agent is needed and the volume of sludge and bulking agent to be handled is reduced. For proper composting to occur, the initial moisture content of the sludge bulking agent mixture should not exceed 60%. For efficient processing the final moisture should be about 45%. The sludge characteristics of key importance to process thermodynamics are solids content and degradable organic. The quantity of heat produced in composting is directly proportional to the amount of degradable solids contained in the sludge. Thus the composting process needs less space, fewer pieces of equipment, less labor, less fuel and smaller facilities. (Baker-IVI)
W85-02991

**EVALUATING DEWATERING ALTERNATIVES,**
Metcalf and Eddy of New York, NY.
J. Anderson, M. Ponte, S. Biuso, D. Brailey, and J. Kantorek.
Biocycle, Vol. 25, No. 7, p 34-35, October, 1985. 2 Fig, 6 Tab.

Descriptors: *Composting, *Sludge drying, *Municipal wastewater, *Clinton County, *New York, Wastewater treatment, Economic aspects, Belt filters, Centrifuges, Cost analysis.

Clinton County, New York is in the process of constructing a 34 dry ton per day enclosed composting system. The project includes upgrading the dewatering facilities at the Plattsburgh Water Pollution Control Plant which is currently able to produce a dewatered sludge at a maximum of 13% solids which is considerably less than the 20% level required. Use of continuous belt filter presses for dewatering municipal wastewater sludge in the US has increased in popularity in the past five years. Belt filters are sized based on two criteria: hydraulic loading gallons per minute per meter of belt width and solids loading pounds of solids per meter of belt width per hour. Design criteria for using the belt filter press are presented. Centrifuges have been used to dewater wastewater treatment sludge since the 1930's. Dewatering centrifuges are available from many manufactureres in a wide range of capacities and configurations. A summary of design criteria used for the cost-effectiveness analysis is presented. The results of a cost comparison for belt filter presses and centrigues are presented. After sufficient testing the belt filter presses displayed a slight economic advantage. Advantages for the belt filter presses were found not only in capital cost and operating cost but also in power requirements. The centrifuge shows an advantage only in the category of odor control as it is in an enclosed system. (Baker-IVI)
W85-02992

**DEWATERING BY THE CAMBRIDGE SDS SYSTEM,**

Cambridge Public Works Dept., MD. Pollution Control Div.
G. W. Spohr.
Biocycle, Vol. 25, No. 7, p 36-37, October, 1984. 7 Fig, 3 Ref.

Descriptors: *Composting, *Sludge drying, *Wastewater treatment, Leaching, Percolation, Sludge thickening.

Gravity sludge thickening is the most rational approach for all kinds of sludges, producing higher total solids concentrations and resulting in increased efficiency. A labor saving drying bed sludge technology is described, the SDS System. In the SDS System the detention time is set for 10 days. The process consists of collecting primary activated sludge mixtures in a wet well with a holding capacity of approximately 6,000 gallons. The sludge is then mixed with hydrated lime yielding a pH value of 11. At this stage, total solids content is about 3.5%. The material is conveyed via a plunger pump to a specially prepared holding bed which is built on a 6 inch layer of macadam and lightly sloped for better runoff and front end loader operation. The holding bed is concrete-walled on three sides with the front wall constructed out of a sandwiched berm of unscreened compost and woodchips. Any plant with a firm ground, and ability to convey and treat the leachate, could be considered a good candidate for this mode of sludge treatment. (Baker-IVI)
W85-02993

**CADMIUM SORPTION AND MOBILITY IN SLUDGE-AMENDED SOIL,**
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
G. R. Cline, and G. A. O'Connor.
Soil Science, Vol. 138, No. 3, p 248-254, September, 1984. 1 Fig, 5 Tab, 24 Ref.

Descriptors: *Cadmium, *Sorption, *Mobility, *Sludge disposal, *Soil amendments, Trace metals, Leaching, Calcareous soils.

Soil amendments may increase the mobility of trace metals, and Cd may be the most mobile trace metal in sludge amended soils. Cadmium sorption was studied in three soils that were unamended, freshly amended, or preconditioned with gamma-irradiated sewage sludge. Metal sorption was studied in the same soils treated with a CaCl2-extract of the sludge. Cadmium sorption was greatest in the unamended soils, less in soils preconditioned with sludge, and least in the freshly amended soils and sludge-extract-treated soils. Reduced free metal ion activity did not explain the treatment effects. Despite the reduction in metal retention effected by various treatments, cadmium mobility was very limited. Short-term and long-term leaching studies showed cadmium movement to be limited to 1 or 2 cm below the zone of sludge incorporation. With time, sludge degrades and Cd retention increases to that in unamended soils. Cadmium availability also is reduced. Cadmium mobility is expected to be very limited in calcareous soils, regardless of sludge treatments. (Moore-IVI)
W85-03097

## 5F. Water Treatment and Quality Alteration

**TOXICOLOGICAL INVESTIGATION AND EVALUATION OF DRINKING-WATER POLLUTION CAUSED BY CHEMICAL WASTES,**
Orszagos Kozegeszegugyi Intezet, Budapest (Hungary).
I. Desi, and G. Somosi.
Ecotoxicology and Environmental Safety, Vol. 8, No. 4, p 315-327, August, 1984. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Drinking water, *Toxicity, *Water pollution effects, *Vac, *Hungary, Pharmaceutical industry, Industrial wastes, Groundwater pollution, Mutagens, Taste, Danube river.

In February 1981 drinking water from a waterworks in Vac (Hungary) proved to have a taste of chemicals and pharmaceuticals. Acute, subacute, in vitro, and animal experiments were performed in the spring and fall of 1981 on samples from bank-filtered drinking-water wells of Vac; from three neighboring observation wells; from water transported from the opposite side of the Danube; from a drinking-water well of a town farther northward; and from Danube water. The most severe toxicity was found in water from two observation wells. Drinking-water samples from the wells in Vac proved to be contaminated, and toxic effects of different degrees were also induced by water from other wells in Vac. Danube water caused changes only in some tests; the control drinking-water well, the samples of one observation well, and of the well on the opposite side of the Danube examined in the fall did not cause any alterations. The toxicity was confirmed by the elevated hemolysis, by the genotoxic effects on human erythrocytes and leukocytes, by the functional changes observed in the nervous system of rats, by alterations detected in the electric activity of the rats' brains, in the learning ability and the behavior of the rats, by the increase in the cytochrome P-450 enzyme level of the liver, and by the chromosome aberrations emerging in mice. The water proved to be inappropriate for human consumption. The contamination is believed to have originated at a pharmaceutical factory waste storage site. (Moore-IVI)
W85-02696

**ASBESTOS IN WATER SUPPLIES OF THE UNITED STATES,**
Health Effects Research Lab., Cincinnati, OH.
J. R. Millette, P. J. Clark, J. Stober, and M. Rosenthal.
Environmental Health Perspectives, Vol. 53, p 45-48, November, 1983. 5 Tab, 20 Ref.

Descriptors: *Asbestos, *Drinking water, Minerals, Fibers, Water pollution, Population exposure.

The review of available data on the concentrations of asbestos in U.S. water supplies suggests that the majority of water consumers are not exposed to asbestos concentrations over 1 million fibers/Liter. A few populations, however, may be exposed to concentrations over 1 billion fibers/L. Of the 538 water supplies for which waterborne asbestos data are available, 8% have concentrations of fibers over 10 million fibers/L. The vast majority of asbestos fibers found in U.S. water supplies are under 5 micro m in length. (Author's abstract)
W85-02703

**ENGINEERING AND OPERATING APPROACHES FOR CONTROLLING ASBESTOS FIBERS IN DRINKING WATER,**
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
G. S. Logsdon.
Environmental Health Perspectives, Vol. 53, p 169-176, November, 1983. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Asbestos, *Pipes, *Asbestos cement, *Drinking water, Filtration, Water distribution, Linings, Coatings, Agressive water, Drilling, Tapping, Flushing.

Research efforts related to water filtration and the protection or rehabilitation of asbestos-cement (AC) pipe that transmits aggressive water are described. When asbestos fibers are present in the source water, filtration plants can be designed and operated to remove most of the fibers using diatomaceous earth filters and granular media filters. When AC pipe is used to transmit aggressive water, formation of a coating on the pipe wall can decrease the extent of deterioration of the pipe and the erosion of fibers from the pipe wall into the water. Water distribution system research revealed that utility operating practices can influence asbestos fiber concentration in drinking water. Drilling and tapping can introduce asbestos-containing debris into the distribution system unless pipe fragments are flushed out under pressure during the tapping process. After asbestos-containing debris has accumulated in the low-flow or dead-end areas of distribution systems, flushing such water mains can cause unusually high fiber counts. (Baker-IVI)
W85-02714

**SELECTING AN ECONOMICAL WATER MAIN REHAB,**
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Civil Engineering/ASCE, Vol. 54, No. 9, p 68-70, September, 1984. 4 Fig, 4 Ref.

Descriptors: *Water mains, *Economic aspects, *Rehabilitation, Calcium carbonate, Scaling, Pipes, Linings, Hydrogen ion concentration, Planning.

Alternative pipe restoring methods are presented to aid the engineer in stretching every dollar to eliminate deposits that form on the inside walls of pipes. The nature of the deposits to be removed or prevented depends on the water's chemical makeup. At low pH, the water is aggressive and tends to pull or dissolve material out of the pipe wall. At high pH, dissolved material, especially calcium carbonate, precipitates in the pipe to form scale on the pipe wall. Chemical addition can minimize future problems, but in most cases it cannot restore lost carrying capacity economically. One possible remedial method is to install additional water mains. If lost carrying capacity causes problems only during peak flow conditions, additional elevated storage can be provided to dampen out peak flows and reduce the distance water must travel from storage. Cleaning or pigging may be most economical. Several passes with the pigs or scrapers are usually required to remove the deposits. Lining the pipe with an inert material usually prevents further loss of carrying capacity. When a pipe is to be cleaned and lined, it must be taken out of service, usually for several days. Temporary bypass lines are usually required to provide water to customers along the pipeline. (Baker-IVI)
W85-02729

**HOW TO BUY A WATER TREATMENT PLANT,**
R. Hill.
Chemical Engineer, No. 405, p 17-21, July, 1984. 1 Fig, 3 Tab.

Descriptors: *Water treatment facilities, *Design criteria, *Planning, Water resources development, Water quality, Water management.

Water treatment engineers tend to categorize natural waters into five broad groups according to their characteristics: upland, groundwater, lowland surface, brackish, and seawater. If no water analysis is available, information on the source of the water allows the designer of the water treatment system to make an intelligent guess at the quality. The design analysis will take into account the seasonal variations and possible blends of waters and allow for the worst case situations. Many water treatment plants are oversized because the treated water quantity has been specified incorrectly. This is particularly true for the batch processing industries where a large flowrate of treated water is needed for a short time to fill a batch reactor. Quite a lot of help can be provided by the water treatment plant supplier if he is consulted early in the design part of the project. There is never only one process route from a given raw water quality to a given treated water quality. The supplier should have a complete range of unit operations at his disposal and be able to discuss their relative merits in terms of capital cost, running costs and ease of operation. In addition, he can discuss the various options on materials for construction. (Baker-IVI)
W85-02765

**MEETING THE CHALLENGE OF POWER PLANT WATER TREATMENT,**
R. C. Rittenhouse.
Power Engineering, Vol. 88, No. 9, p 24-32, September, 1984. 3 Fig, 3 Tab.

Descriptors: *Powerplants, *Water treatment, *Decision making, Planning, Quality control, Design criteria, Dechlorination, Corrosion control, Chlorination, Biofouling.

Biofouling and corrosion control, special situations in cycling units, and water treatment system retrofitting and plant life extension are among the many requirements and problem areas being dealt with by powerplant managers. Specific problems and solutions are offered for the following areas of concern: dechlorination, alternatives to chlorine use, zero discharge requirements, corrosion control, brine concentrators, demineralization, plant life extension, problems with copper, condensate/steam quality, dissolved oxygen, and logic controllers. (Baker-IVI)
W85-02766

**ELECTROCOAGULATION OF POTABLE WATER,**
Norsk Inst. for Vannforskning, Oslo.
E. A. Vik, D. A. Carlson, A. S. Eikum, and E. T. Gjessing.
Water Research, Vol. 18, No. 11, p 1355-1360, 1984. 7 Ref, 2 Tab, 9 Ref.

Descriptors: *Drinking water, *Pretreatment of water, *Electrocoagulation, *Coagulation, Electrochemistry, Humus, Alum, Aluminum, Hydrogen ion concentration, Water treatment.

Coagulation caused by electrolytically produced ions (electrocoagulation) followed by filtration has been studied as a possible alternative to the conventional coagulation process. Electrochemical processes have been used in water and wastewater treatment since 1887. Electrocoagulation is looked upon as an interesting process in use at small water treatment plants. There are several important design aspects of this process which deserve further study. This study presents results showing the correlation between the current density and the aluminium dosing and provides results showing the necessary overpotential. The process has proved efficient with regard to removal of aquatic humus. A comparison of this method with conventional coagulation shows that the aquatic humus is removed equally well with both methods. Conventionally coagulated water (using alum) contains higher concentrations of sulfate and thus has a higher specific conductivity than the electrochemically treated water. The electrochemically treated water contains higher residual aluminium concentrations than the conventionally treated water due to the higher pH values. (Author's abstract)
W85-02906

**REMOVAL OF BACTERIA FROM WATER BY ADSORPTION TO MAGNETITE,**
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.
I. C. MacRae, and S. K. Evans.
Water Research, Vol. 18, No. 11, p 1377-1380, 1984. 5 Tab, 4 Ref.

Descriptors: *Bacteria, *Water treatment, *Adsorption, *Magnetite, Water quality control, Magnesium, Calcium, Disinfection.

The effectiveness of the Sirofloc process magnetite preparation was evaluated for the removal of bacteria from water during three adsorption stages. The usefulness of acid washing of the magnetite in the desorption of adsorbed bacteria and the effect of multiple alkali-acid regeneration cycles on the ability of a magnetite sample to remove bacteria from water were also investigated. Using three adsorption stages reduced the numbers of bacteria in a suspension by five log cycles. Removal of calcium and magnesium from the magnetite surface by acid washing resulted in improved desorption of the bacterial cells. (Baker-IVI)
W85-02909

**KINETICS OF MICROBIAL INACTIVATION BY CHLORINE - I; REVIEW OF RESULTS IN DEMAND-FREE SYSTEMS,**
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W85-02917

**KINETICS OF MICROBIAL INACTIVATION BY CHLORINE - II; KINETICS IN THE PRESENCE OF CHLORINE DEMAND,**
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W85-02918

**EFFECT OF FILTER PORE SIZE ON THE EVALUATION OF ALUMINUM COAGULANTS TO REMOVE FULVIC ACID FROM WATER,**
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
E. Diamadopoulos, and D. R. Woods.
Water Research, Vol. 18, No. 11, p 1455-1459, 1984. 10 Fig, 11 Ref.

Descriptors: *Coagulants, *Water treatment, *Aluminum, *Filtration, Membrane processes, Fulvic acid, Membranes, Filter media.

The evaluation of aluminum coagulants to remove fulvic acid from water depends on the process of separating the precipitate from the liquid phase. The interactions between fulvic acid and membrane filters during the routine work of filtration, in the presence and absence of aluminum, were determined and the effect of the membrane pore size on the apparent efficiency of aluminum to remove fulvic acid from water was examined. When pure fulvic acid solutions were filtered through membrane filters, some organics were initially adsorbed on the filter, but the filtrate concentration rapidly rose to the original fulvic acid levels for both types of the filters tested. When aluminum-treated fulvic acid solutions were filtered through membrane filters, the filtrate concentration depended on the filter pore size. In general, filters with a 0.10 micro m pore size were able to remove more particles from water than were the 0.45 micro m filters. Differences of up to 80% of the original fulvic acid concentration were observed. The 0.45 micro m filers showed a deep-filter like behavior for small particles. When little material was deposited on the filter and the filter pores were relatively clean, small particles at times accounting for up to 80% of the original fulvic acid concentration passed into the filtrate. After clogging of the pore occurred, the 0.45 micro m filters were able to remove smaller particles. (Baker-IVI)
W85-02919

**EFFECT OF PH, APPLICATION TECHNIQUE, AND CHLORINE-TO-NITROGEN RATIO ON DISINFECTANT ACTIVITY OF INORGANIC CHLORAMINES WITH PURE CULTURE BACTERIA,**
California Univ., Irvine. Program in Social Ecology.
N. R. Ward, R. L. Wolfe, and B. H. Olson.
Applied and Environmental Microbiology, Vol. 48, No. 3, p 508-514, September, 1984. 1 Fig, 4 Tab, 34 Ref.

Descriptors: *Disinfection, *Hydrogen ion concentration, *Chlorination, *Nitrogen, *Chloramines, Bactericides, Escherichia coli, Salmonella, Pseudomonas, Klebsiella, Enterobacter, Ammonia.

The influence of pH, application technique, and chlorine-to-nitrogen weight ratio on the bactericidal activity of inorganic chloramine compounds was determined with stock and environmental strains of Escherichia coli, Salmonella spp., Pseudomonas aeruginosa, Klebsiella pneumoniae, and Enterobacter cloacae. The rate of inactivation increased from 1.5 to 2 times as the chlorine-to-nitrogen weight ratio was adjusted from 2:1 to 5:1, 5 to 6 times as the pH was decreased from 8 to 6, and 5 to 6 times as the concentrations was increased from 1 to 5 mg/liter. Separate additions of free chlorine and ammonia (concurrent addition and preammoniation) into seeded water at or below pH 7.5 resulted in killing comparable to that observed with free chlorine (99% inactivation in less than 20 s). At pH 8, inactivation by separate additions was considerably slower and was comparable to that by preracted chloramine compounds (99% inactivation in 25 to 26 min). Determination of the effectivness of inorganic chloramine compounds as primary disinfectants for drinking water must consider the method of application, of pH, and concentrations of chlorine and ammonia. (Author's abstract)
W85-02933

**INACTIVATION OF GIARDIA LAMBLIA CYSTS WITH OZONE,**
Ohio State Univ., Columbus. Water Resources Center.
G. B. Wickramanayake, A. J. Rubin, and O. J. Sproul.
Applied and Environmental Microbiology, Vol. 48, No. 3, p 671-672, September, 1984. 2 Fig, 1 Tab, 7 Ref. EPA grant R808150-02-0.

Descriptors: *Giardia, *Ozonation, *Disinfection, Water treatment, Chlorination, Protozoa.

The effectiveness of ozone was investigated as an alternative disinfectant for the inactivation of Giardia lamblia cysts. The cysts were inactivated at three different ozone concentrations at 5 and 25 degrees C and pH 7. The concentration-time products for 99% inactivation were 0.53 and 0.17 mg-min/liter at 5 and 25 C, respectively. These products were significantly lower than those reported for chlorine. G. lamblia cysts were only about twice as resistant to ozone inactivation as poliovirus 1 at a neutral pH and 5 and 25 C. G. lamblia cysts were more resistant to inactivation by ozone and chlorine than Escherichia coli by about 1 and 3 orders of magnitude, respectively, at low temperatures. There are fewer differences in resistance among these three organisms to ozone inactivation than to chlorine inactivation. (Collier-IVI)
W85-02937

**COMPARISON OF METHODS OF ENUMERATING COLIFORMS AFTER UV DISINFECTION,**
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W85-02938

**REOVIRUS REMOVAL AND INACTIVATION BY SLOW-RATE SAND FILTRATION,**
Utah Water Research Lab., Logan.
L. K. McConnell, R. C. Sims, and B. B. Barnett.
Applied and Environmental Microbiology, Vol. 48, No. 4, p 818-825, October, 1984. 7 Fig, 4 Tab, 38 Ref.

Descriptors: *Reoviruses, *Sand filtration, *Filtration, Water treatment, Viruses, Adsorption, Filters, Disinfection.

Laboratory column studies were conducted at the Utah Water Research Laboratory, Logan, Utah, to evaluate reovirus removal from drinking water supplies by slow-rate sand filtration (SSF). Columns, constructed to simulate a full-scale SSF field operation, were inoculated with reovirus at ca. 1,000-times-greater concentrations than those typically found in domestic sewage. Reovirus removal and inactivation were investigated as functions of filter maturity and other filter sand characteristics. Reovirus removal studies demonstrated that the SSF process is capable of reducing reovirus in influent water by a minimum of 4 log concentration units under certain conditions of water quality, flow rate, and sand bed construction. Infectious reovirus was not detected in effluent samples from any of the sand beds studied, after inoculation of the SSF columns; therefore, removal efficiencies were not affected significantly by characteristics, including age, of the two filter sands evaluated. Studies conducted with radioactively labeled reovirus demonstrated that reovirus removed from influent water was distributed throughout the entire length of the filter beds. Concentrations of reovirus in the filter sands decreased with increasing bed depth. The greatest removal occurred in the top few centimeters of all sand beds. No infectious reovirus could be detected in clean or mature sand bed media, indicating the reoviruses were inactivated in the filter. (Author's abstract)
W85-02940

**IMPACT OF CHLORINE, CHLORINE DIOXIDE AND OZONE ON THE OXIDATION OF NTA DURING DRINKING WATER TREATMENT,**
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
J. Hrubec, M. J. 't Hart, P. Marsman, and J. A. Luijten.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 5, p 548-555, November, 1984. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Water treatment, *Disinfection, *Chlorine, *Nitrilotriacetic acid, Oxidation, Ozone, Chlorine dioxide, Chemical reactions, Drinking water, Mutagens, Netherlands.

The removal of nitrilotriacetic acid (NTA) upon chlorine, chlorine dioxide and ozone treatment of drinking water was investigated. The possible formation of mutagenic substances from the reaction of NTA with these oxidants was considered along with the formation of halogenated reaction products of NTA with chlorine and chlorine dioxide, as far as analyses of the group parameter adsorbable organic halogens, extractable organic halogens and volatile organic halogens allow. Under typical conditions of the drinking water practice in the Netherlands, characterized by application of low doses of both chlorine and chlorine dioxide, no, or only a slight, degradation of NTA can be expected. Formation of halogenated organics, by reaction of NTA with chlorine and chlorine dioxide during water treatment, which can be detected with the analytical methods used, can be regarded as highly improbable. No increase in mutagenic activity was found in water with NTA addition treated with ozone and chlorine. (Baker-IVI)
W85-02965

**FLOCCULATION AND TURBULENCE FROM BUBBLE-INDUCED MIXING,**
Edinburgh Univ. (Scotland). Dept. of Civil Engineering.
G. L. McConnachie.
Journal of the Institution of Water Engineers and Scientist, Vol. 38, No. 4, p 337-347, August, 1984. 8 Fig, 2 Tab, 46 Ref.

Descriptors: *Flocculation, *Turbulence, *Bubble-induced mixing, Mixing, Water treatment, Suspended solids.

Mixing by air bubbles to promote the flocculation of suspended particles in water treatment was studied using different bubble sizes and air flows as well as results from turbulence measurements using laser-Doppler anemometry. Tapered agitation intensity gave significant improvement in efficiency over fixed agitation. Minimum residual turbidity occurs at relatively low air-flows. With the expected improvement from compartmentalized tanks and subsequent filtration, bubble agitation may be more economical than paddle mixers in conventional systems. Buble size has an influence on the efficiency of flocculation; 0.5-1.5 mm gave the lowest residual turbidity. The flocculation efficiency is related to the degree of turbulence induced and appears to be influenced by the distribution of turbulence within the reactor. An even distribution of many bubble streams in a tank would be beneficial in promoting flocculation. (Moore-IVI)
W85-03021

**ARSENIC IN NOVA SCOTIAN GROUNDWATER,**
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Centre.
For primary bibliographic entry see Field 5A.
W85-03032

**BIOFOULING CONTROL THROUGH TARGETED CHLORINATION,**
W. Chow, J. S. Maulbetsch, and Y. G. Mussalli.
Power Engineering, Vol. 84, No. 10, p 38-41, October, 1984. 5 Fig, 2 Tab.

Descriptors: *Chlorination, *Powerplants, *Cooling water, *Biofouling, Condensers, Economic aspects, Water treatment.

Targeted chlorination is a new technique for reducing microbiological fouling of condensers and minimizing chlorine discharges in powerplant cooling water. The advantages of the method are best described in contrast to conventional chlorination, where chlorine is injected into and mixed with the cooling water well upstream of the pilot condenser system. Targeted chlorination seeks to direct a chlorinated flow to one small section of the condenser at a time. This flow can be at higher than normal chlorine concentrations because it is mixed in the condenser exit water box with a larger unchlorinated flow. Each section is chlorinated for a much shorter time permitting sequential treatment of the entire condenser within the prescribed time limit. Tests at a utility plant test site having complete operating records with its concurrent chlorination system will provide a baseline against which results can be compared and evaluated. (Baker-IVI)
W85-03051

## 5G. Water Quality Control

**ENVIRONMENTAL ENGINEERING AND PUBLIC HEALTH ASPECTS OF ALTERNATE DAIRY WASTE MANAGEMENT TECHNIQUES DESIGNED TO PROTECT GROUND WATER QUALITY,**
California State Coll., San Bernardino. Dept. of Health Science and Human Ecology.
For primary bibliographic entry see Field 5E.
W85-02724

**SIGNIFICANCE OF THE 129 SUBSTANCE EEC-LIST FOR WATER QUALITY PROTECTION (DIE BEDEUTUNG DER 129 STOFFE DER EG-LISTE FUR DEN GEWASSERSCHUTZ),**
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
K.-G. Malle.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 3, p 75-81, June, 1984. 9 Tab, 50 Ref.

Descriptors: *Rhine River, *Germany, *Toxicity, *Pollutants, Water pollution prevention, Mercury, Cadmium, Regulations, Water quality standards.

With respect to the implementation of the EEC-directive 76/464/EWG for the protection of surface waters against pollution by discharge of certain dangerous substances the EEC-commission has named 129 individual substances for priority investigation. Directives for the discharge of mercury and cadmium have already been released. The investigation of the rest of the substances is well under way. This paper lists the acute toxicity data of the substances and is allotting them to the analytical results of Rhine water. It becomes evident that for a number of substances analytical data and even microanalytical procedures are missing. From a critical check of all the data the following questions arise for future work: which risk is involved with substances not detectable in surface waters; which difference is necessary between toxicity data and concentration in waters; which substances should be reduced according to list I-procedure or list II-procedure, respectively. (Author's abstract)
W85-02754

**WATER QUALITY CONTROL AND ITS EFFECT ON THE CONCENTRATION OF HEAVY METALS IN PORT KEMBLA HARBOUR, N.S.W.,**
Biological Lab., Cold Spring Harbor, NY.
P. J. Moran.
Marine Pollution Bulletin, Vol. 15, No. 8, p 294-297, August, 1984. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *New South Wales, *Australia, *Port Kempla Harbour, *Heavy metals, *Water pollution control, Allans Creek, Iron, Lead, Zinc, Copper, Cadmium, Harbors.

Water quality control programs have been implemented by the industries surrounding Port Kempla Harbour, New South Wales, Australia, in an attempt to reduce the impact of pollution. The concentrations of five heavy metals (iron, lead, zinc, copper and cadmium) were measured at two sites in the harbor over a period of 9 months. In comparing the results of this study with those recorded previously at these sites during 1974 and 1978, it is shown that the concentrations of all five metals have decreased substantially over the last decade. The decrease has been a continual one with most heavy metal levels declining between 1974 and 1978 and again between 1978 and 1980/81. Over the entire period, from 1978 to 1980/81, the percentage decrease in these levels ranged from 67% (cadmium) to 97% (iron) in the middle of the harbor and from 72% (cadmium) to 99% (lead and zinc) at the entrance to Allans Creek. The substantial decrease in heavy metal concentration since 1974 has been due to the water quality control programs implemented by many of the surrounding industries. (Collier-IVI)
W85-02761

**BIOLOGICAL PRODUCTIVITY OF LAKE QARUN (ARAB REPUBLIC OF EGYPT),**
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
For primary bibliographic entry see Field 2H.
W85-02851

**PROTECTION OF GROUNDWATER FROM OIL POLLUTION IN THE VICINITY OF AIRPORTS,**
J. Svoma, and V. Houzim.
Environmental Geology and Water Sciences, Vol. 6, No. 1, p 21-30, 1984. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Groundwater pollution, *Airports, *Water pollution control, Hydrocarbons, Groundwater, Oil pollution, Monitoring, Water pollution sources.

The potential danger to the quality of groundwater close to airports is due to a combination of several ecologically unfavorable factors. Airports are usually situated in the proximity of a groundwater divide, or in wide valleys. Causes of pollution include the sheer volume of fluid being handled constantly, the physicochemical properties of hydrocarbons, and technical errors in the transport and storage of fuels. Oil hydrocarbons in concentrations of tenths to units of milligrams per liter have been found in snow in the vicinity of runways. Carcinogenic benzopyrenes are accumulated in soil. Oil hydrocarbons spread in rock formations as a separate layer as well as in solution. In porous permeable formations, pollution by a free product affects areas on the order of tens of meters, while hydrocarbons in solution penetrate to distances of hundreds of meters or even kilometers. Fissured rocks are cause for even more complex conditions for the spreading of oil based substances. Preventive protection of groundwater and mineral waters using monitoring devices is being carried out at some major airports. Observation wells situated in the tectonic zone can also be used for reparative pumping. (Baker-IVI)
W85-02859

**ELECTRICAL RESISTIVITY INVESTIGATION OF POTENTIAL CAVITIES UNDERLYING A PROPOSED ASH DISPOSAL AREA,**
Environmental Science and Engineering, Inc., Gainesville, FL.
B. J. Denahan, and D. L. Smith.
Environmental Geology and Water Sciences, Vol. 6, No. 1, p 45-49, 1984. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Crystal River, *Florida, *Electrical resistivity, *Waste disposal sites, *Electrical studies, Geophysics, Facility siting, Electrodes, Solution cavities, Facility siting, Limestone, Geophysics.

Measurements of electrical resistivity anomalies using a Wenner electrode array in a profiling mode were conducted over a 105-acre area near Crystal River, Florida. Analyzed results of collected data were used to determine the likelihood of subsurface solution cavities beneath a proposed ash dis-

posal area. 'Sounding' measurements with electrode spacing values extending up to 100 feet and Lee electrode measurements were used to identify and locate specific anomaly maxima. Identified anomalies on the order of 200 ohms-feet contrasted with expected values of 300 to 400 ohms-feet and were attributed to lower resistivities inherent in water-filled solution cavities below a shallow water table. Prominent cavity complexes at 5 to 15 feet depth were predicted in areas of low resistivity anomalies in the otherwise geoelectrically uniform, Eocene Ocala limestone. Shallow test borings confirmed the presence of a significant concentration of shallow cavities in the predicted areas. This study demonstrated the feasibility of electrical resistivity measurements as a reconnaissance tool to economically determine subsurface cavities and to aid in developmental and environmental planning. (Author's abstract)
W85-02861

**OVERVIEW OF THE US-USSR JOINT AGREEMENT ON ENVIRONMENTAL PROTECTION RELATED TO PREVENTION OF WATER POLLUTION,**
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
For primary bibliographic entry see Field 6E.
W85-02881

**PHOSPHORUS MANAGEMENT LP MODEL CASE STUDY,**
New Jersey Dept. of Environmental Protection, Trenton.
T.-R. Jenq, M. L. Granstrom, S.-F. Hsueh, and C. G. Uchrin.
Water Resources Bulletin, Vol. 20, No. 4, p 511-520, August, 1984. 5 Fig, 9 Tab, 21 Ref.

Descriptors: *Cost analysis, *Phosphorus, *Water quality management, *Linear programming, *Carnegie Lake, *New Jersey, Nutrients, Eutrophic lakes, Water pollution control, Nonpoint pollution sources.

The Carnegie Lake basin in New Jersey has a drainage area of approximately 150 sq mi. The present population of the study area is approximately 70,000 people. due to develoment potential, the forecasted year 2000 population is 200,000. Carnegie Lake is not a true lake, but an impounded river. It suffers from excessive nutrient problems. A linear programming model to assess the cost-effectiveness of appropriate point and nonpoint phosphorus control measures was constructed for Carnegie Lake, and the model was tested for present and future conditions. Feasible solutions were obtained only after significant relaxation of receiving water quality standards. The high levels of point source treatment required to meet the in-stream water quality standards and the mesotrophic loading conditions suggest that a source control solution may not be feasible. Due to the nutrient cycles in natural water systems, the eutrophication problems of Carnegie Lake may not be immediately mitigated even if the target loadings are achieved. (Moore-IVI)
W85-02977

**WATER SUPPLY AND FORESTRY - A CONFLICT OF INTERESTS: CRAY RESERVOIR, A CASE STUDY,**
For primary bibliographic entry see Field 6G.
W85-03020

**WATER AND HEALTH IN AFRICA,**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
Water International, Vol. 9, No. 2, p 51-57, 1984. 1 Fig, 2 Tab, 44 Ref.

Descritors: *Public health, *Water quality control, *Africa, Waste disposal, Sanitation, Planning, Decision making, Wastewater treatment, Education, Public participation, Developing countries.

The health situation throughout Africa is surveyed as it relates to water usage and sanitary waste disposal practices. Exact quantitative interpretations of the entire water related health system are difficult to obtain because of the complexity of the many factors impinging upon health and the inherent difficulty in gathering data in the scattered villages where the greater majority of the population is still to be found. In addition to quality of water, the quantity of water available is also an important factor for the prevention of water related diseases. Because the causative factors of disease are multiple, the solution will not involve just a single action, even if that is providing clean water. A number of health workers have stressed that contemporary health care in Africa must adopt a holistic view. Many African countries are now placing greater stress on health education of the community. Health workers and engineers have been learning how to work together in dealing with water related health problems. A variety of sewerage systems is now available and through careful decision making, those schemes which are economically suited to the region can be made operable. (Baker-IVI)
W85-03026

**ACID RAIN PERSPECTIVES: A TALE OF TWO COUNTRIES,**
B. Hileman.
Environmental Science and Technology, Vol. 1, No. 1, p 341A-344A, November, 1984. 2 Fig.

Descriptors: *Acid rain, *Water pollution control, *Canada, *United States, Regulations, Emissions control, Sulfur dioxide, Economic aspects, Air pollution.

To understand the differences in approach to the acid rain problem it is important to know certain differences between the two countries, Canada and the United States concerning this problem. Control plans for emission reductions in Canada need to be less complex than those in the United States. The major sources of sulfur dioxide in Canada are few. The opposite is true in the United States. A second important difference is that the major sources of SO2 in the US appear to be widely separated from the most sensitive regions at immediate risk from acid rain, whereas in Canada the major sources lie within or close to sensitive regions. Total SO2 emissions from the eastern US are more than five times greater than those from eastern Canada. Canada does not have a single scrubber on a smelter or powerplant in contrast to the US which has a number of utilities with scrubbers. Cost of emission reductions is each country is considered. (Baker-IVI)
W85-03055

**TRADEOFFS IN WATER QUALITY MANAGEMENT,**
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W85-03063

**TWO-STAGE URBAN RUNOFF FORECAST MODEL,**
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2E.
W85-03065

**HYDROGEOCHEMICAL INTERACTION BETWEEN A MUNICIPAL WASTE STABILIZATION LAGOON AND A SHALLOW AQUIFER,**
North Dakota Univ., Grand Forks. Dept. of Geology.
A. E. Kehew, F. J. Schwindt, and D. J. Brown.
Groundwater, Vol. 22, No. 6, p 746-754, November-December, 1984. 9 Fig, 1 Tab, 17 Ref.

Descriptors: *Stabilization lagoons, *Groundwater pollution, *North Dakota, Water pollution sources, Unconfined aquifers.

Unlined municipal waste stabilization lagoons are potential sources of groundwater contamination. Fourteen monitoring wells were installed around the McVille, North Dakota lagoon, a site at which the impoundment is excavated into permeable sediments of an unconfined glaciofluvial aquifer with a shallow water table. The infiltrating waste water dissolves iron oxides, thereby releasing dissolved iron to the groundwater flow system. Ammonium concentrations in the downgradient ground water are higher than the total nitrogen content of the waste water. A possible explanation for these ammonium concentrations is the conversion of nitrate in the upgradient ground water to ammonium as it passes beneath the pond. Downgradient ammonium concentrations may also be higher as a result of rapid infiltration of waste water from the cell used for periodic overflow discharges from another cell, which avoids possible attenuation by adsorption because of the lack of a sludge layer in this receiving cell. As ground water moves further downgradient, cation exchange processes reduce ammonium concentration to very low levels. The contaminant distribution at the McVille lagoon is not typical of other sites because the contaminant plume at McVille is larger and contains higher concentrations of most constituents than the other lagoons. Despite the extent of the plume at McVille, attenuation of the more harmful contaminants of those parameters measured in the study occurs within a relatively short distance of the lagoon. Impoundments with natural sludge layers may, in some cases, function as well as lined lagoons, with respect to minimizing ground water contamination. The practice of discharging waste water into impoundments where rapid infiltration occurs, however, appears to increase degradation of groundwater quality. (Baker-IVI)
W85-03154

# 6. WATER RESOURCES PLANNING

## 6A. Techniques Of Planning

**CIRCULAR VS. LINEAR WATER SYSTEMS, GOING BACK TO NATURE'S WAY,**
Sheaffer and Roland, Inc., Chicago, IL.
K. J. R. Sheaffer.
Environment, Vol. 26, No. 8, p 10-15 and 42-44, October, 1984. 3 Fig, 2 Ref.

Descriptors: *Water management, *Planning, Water supply development, Water treatment, Wastewater treatment, Management.

Proponents of a linear system of water management visualize water flowing in a straight line from source to users to receiving streams and on to the sea. They claim there is adequate water to serve indefinitely as both a source of supply and to dilute and carry away municipal sewage discharged into streams and other natural bodies of water. Those who favor a circular system argue the merits of nature's inviolable law of return. By sending the used water back to the natural cleansing systems of soil, plants, air and sunshine, it could be reclaimed for repeated reuse. The linear approach was adopted and for years appeared to be working. As cities continue to grow they must reach further and further away for continued supplies of useable water because nearby supplies have become polluted. The linear approach has been labeled a technological failure with design goals being unmet. The circular approach, which uses wastes as raw materials, must replace the linear approach, which seeks to get rid of wastes by discharge into some receiving body of water. In the circular approach, capital expenditures are directed to the development of facilities that will use wastes as raw materials to generate food, fiber, and energy resources. Barriers that block the way for changing the emphasis in the nation's water management from linear to circular are discussed. (Baker-IVI)
W85-03039

**METHODS OF FITTING A STRAIGHT LINE TO DATA: EXAMPLES IN WATER RESOURCES,**
Geological Survey, Reston, VA.
R. M. Hirsch, and E. J. Gilroy.

Water Resources Bulletin, Vol. 20, No. 5, p 705-711, October, 1984. 5 Fig, 1 Tab, 23 Ref.

Descriptors: *Statistical analysis, *Water resources development, *Regression analysis, Mathematical equations.

Three methods of fitting straight lines to data are described and their purposes are discussed and contrasted in terms of their applicability in various water resource contexts. The three methods are ordinary least squares (OLS), least normal squares (LNS), and the line of organic correlation (OC). The methods are evaluated for use in estimating individual values of one variable from observation on a related variable, calibration of an instrument, the estimating of multiple values of one variable from multiple observations of another variable, the description of a relationship betweeen two variables, and the description of a geographic trajectory. (Baker-IVI)
W85-03136

## 6B. Evaluation Process

**YANGTZE ENGINEERS AIM HIGH.**
Engineering News-Record, Vol. 213, No. 4, p 26-29, July 26, 1984. 6 Fig.

Descriptors: *Dam construction, *Water resources development, *Yangtze River, *China, *Three Gorge Dam, Management, Planning, Construction, Design criteria.

Planning for the Three Gorge Dam on the Yangtze River started in 1951. The Three Gorge flood-control, power, irrigation and navigation scheme will be one of the world's largest civil-engineering works comprising an 11 million cubic m gravity dam, two powerplants to house 26 500-Mw turbine generators, two 80 m high vertical shiplifts, a double lane lock on the left bank capable of transporting 50 million long tons of cargo a year up 87 m in three equal steps, spillways, low-level outlets and powerplant discharges capable of passing a maximum probable flood of 120,000 cu m per sec. A new construction agency will be established specifically for Three Gorge and a system of bonuses and penalties will be incorporated. (Baker-IVI)
W85-02753

**CENTRAL ARIZONA WATER CONTROL STUDY: A COMPARISON OF ALTERNATE PLANS USING CONCORDANCE ANALYSIS AND MULTI-DIMENSION SCALING,**
York Univ., Downsview (Ontario). Dept. of Geography.
B. H. Massam.
Water Resources Bulletin, Vol. 20, No. 4, p 483-491, August, 1984. 3 Fig, 6 Tab, 12 Ref.

Descriptors: *Evaluation, *Alternative planning, *Water management, *Concordance analysis, *Multi-dimensional scaling, *Arizona, Economic aspects, Social aspects, Environmental effects, Management planning.

The Central Arizona Water Control Study (CAWCS) was initiated by the Bureau of Reclamation in 1978. The study attempted to identify and evalute alternate water management schemes for Central Arizona. By 1981 a set of seven plans had been developed and for each a assessment on a number of economic, environmental, and social factors had been undertaken. This paper offers a formal procedure, using concordance analysis and multi-dimension scaling, to compare alternate plans using multiple factors in order to produce a classification of the attractiveness of the alternatives. Empirical data for the CAWCS are used to clarify the procedure. The results of the formal analysis are compared to those produced by the CAWCS. A critique of the formal procedure is offered, and it is suggested that it may have utility to assist in the collection of data as well as in the search for a best plan. The procedure allows a number of different types of sensitivity tests to be conducted. (Author's abstract)
W85-02974

**PHOSPHORUS MANAGEMENT LP MODEL CASE STUDY,**
New Jersey Dept. of Environmental Protection, Trenton.
For primary bibliographic entry see Field 5G.
W85-02977

**REUSE OF AGRICULTURAL DRAINAGE WATERS: AN ECONOMIC ANALYSIS,**
California Univ., Riverside.
For primary bibliographic entry see Field 3C.
W85-02978

**DETERMINATION OF CROP PRODUCTION LOSS DUE TO INADEQUATE DRAINAGE IN A LARGE WATERSHED,**
Iowa State Univ., Ames. Dept. of Agricultural Economics.
R. S. Kanwar, H. P. Johnson, and T. E. Fenton.
Water Resources Bulletin, Vol. 20, No. 4, p 589-597, August, 1984. 3 Fig, 10 Tab, 9 Ref.

Descriptors: *Evaluation, *Crop yield, *Drainage, *Iowa, Tile drains, Drainage coefficient, Drainage districts, Des Moines River basin.

Results are presented for a crop production evaluation method designed to assess the magnitude of crop damage due to inadequate drainage in a large watershed of Iowa, the Des Moines River basin. A method was developed for determining crop yields at various levels of inadequate and adequate drainage, and the frequencies of occurrence of inadequately drained areas at various levels of natural drainage in this watershed. Information on the current status of drainage of the watershed was collected through personal interviews with 256 farmers from 60 legal drainage districts. About 95% of the area in upper Des Moines River basin has inadequate district mains or main outlet drains currently having a design capacity of < or = 0.64 cm/day drainage coefficient; 81% of the area in the watershed has the potential for further improvement of drainage to a high level of drainage by simply increasing the capacity of district mains to 1.27 cm/day drainage coefficient. There were only 29 fields at no drainage level and 85 fields at intermediate level of drainage within naturally very poorly drained soils in a sample of 298 fields. Most of the areas affected by inadequate tile drainage at the field level are very small in size. These small areas contribute significantly to the overall crop production losses in the watershed. Inadequate drainage in the watershed is currently responsible for crop yield reduction equal to about one-third of the maximum yield potential for average weather conditions. (Moore-IVI)
W85-02987

**ECONOMICS OF CHANGES IN IRRIGATION MANAGEMENT IN PAKISTAN; AN INTEGRATIVE MODELING APPROACH,**
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W85-03029

**WATER SUPPLY AND HEALTH IN DEVELOPING COUNTRIES: SELECTIVE PRIMARY HEALTH CARE REVISITED,**
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. Briscoe.
American Journal of Public Health, Vol. 74, No. 9, p 1009-1013, September, 1984. 1 Fig, 2 Tab, 36 Ref.

Descriptors: *Sanitation, *Water quality control, *Developing countries, Water supply development, Planning, Public health, Cost analysis.

The inclusion of water supply and sanitation programs as a component of primary health care (PHC) has been questioned on the basis of calculations of the costs of these programs per infant death averted. The procedures used in these cost effectiveness calculations are examined. It is determined that the calculations are misleading since gross rather than net costs have been used and the health impact of these programs underestimated. The methodology used is biased against water supply and sanitation and other programs with multiple outputs. The time constraints facing mothers in implementing PHC programs, as well as the contribution of improved water supplies in alleviating these constraints are outlined. Data show that if poor women in developing countries were to choose the mix of activities included in PHC programs, improved water supplies would frequently constitute part of that mix. (Baker-IVI)
W85-03040

**SALT GRADIENT PONDS: INVESTMENT TIMING MODEL,**
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 3C.
W85-03061

**WATER RESOURCES MANAGEMENT: INTERNATIONAL CHALLENGE AND OPPORTUNITIES,**
Johns Hopkins Univ., Baltimore, MD. Dept. of Sanitary Engineering and Water Resources.
A. Wolman.
Water Resources Bulletin, Vol. 20, No. 5, p 647-650, October, 1984.

Descriptors: *Planning, *Evaluation, *Water resources development, *Water supply development, Developing countries, Sanitation, Public health.

Water supply for potable and hygienic purposes is presented as symbolic of the global issues confronting 4.8 billion people. Targets for meeting the needs of those without adequate water supplies were exemplified by the international agencies in the International Water and Sanitation Decade of 1980-1990. The pace of accomplishment has been slow. Constraints are reviewed in detail. Challenges for reducing these constraints and increasing the pace of installations are presented. The potential for a global public works program unprecedented in history is reviewed. (Baker-IVI)
W85-03129

**INSTITUTIONS AND TECHNOLOGY: KEYS TO BETTER WATER MANAGEMENT,**
W. B. Lord.
Water Resources Bulletin, Vol. 20, No. 5, p 651-656, October, 1984. 4 Ref.

Descriptors: *Water management, *Technology, Planning, Decision making, Evaluation, Social values.

Water management technology consists of those behaviors and artifacts which are used to manipulate the hydrologic variables within the environment, such as reservoir storage, groundwater pumping, irrigation methods, water treatment, primary, secondary, and tertiary wastewater treatment, desalination, and weather modification. Seven considerations are offered on how water management can be improved. These include separating fact from value, separating social value from interest, achieving efficient water use and allocating the surplus, windfalls and wipeouts, internalizing externalities, technological changes or institutional change. It is emphasized that technology and institutions are inseparable. Technology cannot be developed or applied except within the framework of social institutions, and institutions must work through technology to make a difference in the state of the nonhuman world. Good water management, or any similar public policy goal, can be achieved only through the coordinated use of technology and social institutions. (Baker-IVI)
W85-03130

**IMPROVING WETLAND POLICY THROUGH AMELIORATION OF ADVERSE EFFECTS ON LOCAL ECONOMIES,**
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
J. A. Leitch, and D. F. Scott.

Water Resources Bulletin, Vol. 20, No. 5, p 687-693, October, 1984. 1 Tab, 24 Ref.

Descriptors: *Wetlands, *Economic aspects, *Water resources development, Model studies, Water policy.

Public ownership of land creates several problems for state and local decision makers. Those problems are summarized and particular emphasis is placed on economic problems that may arise in local areas. Input-output analysis is used to evaluate local economic impacts of public investment. This approach takes into account direct, indirect, and induced effects of changes in expenditure and income flows within the region being examined. It explicitly takes into account the economic interdependencies that exist between sectors in a regional economy. An example is presented of converting productive agricultural land to wildlife habitat considering the payment required to compensate the landowner and the payment required to maintain personal income in the local economy. Public agencies presumably act in the public interest, which means that on balance society is better off as a result of a specific action. However, while the gains may outweight the losses in such actions, it is important to consider those losses and determine adequate compensation. Presumably, those benefiting should be willing to compensate those who are adversely affected if the gains outweigh the losses. (Baker-IVI)
W85-03134

**ECONOMICS OF TIMING STORM DRAINAGE IMPROVEMENTS,**
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
H. C. Cochrane, and P. C. Huszar.
Water Resources Research, Vol. 20, No. 10, p 1331-1336, October, 1984. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Economic aspects, *Storm runoff, Flood protection, Decision making, Planning, Management, Storms, Runoff.

An important component of optimizing storm drainage improvements is the timing of their implementation. A framework for considering the timing of storm drainage projects is advanced. First a relationship is specified for the net present value NPV of a project which is indicative of the issues commonly raised by city engineers, storm drainage boards, city councils, and engineering consultants. This relation is then corrected and simplified to an operational form. Finally, the calculation of the optimum time to construct a drainage project is illustrated for the cases of a new and an old community. The optimum time to construct a storm drainage project apears to depend upon the rate of growth of new structures, the rate of appreciation of structures at risk, the degree to which the area is developed, the discount rate, and the life of the project. The magnitude of the project's NPV is affected by the number of structures that can occupy the project area, the initial value per structure at risk, and the percentage of structure values expected to be lost annually due to flooding before and after protection is provided. In general, it seems that projects in urbanizing areas may be optimally delayed. The combination of the growth of new structures and the appreciation of existing structures is likely to more than offset rising construction costs for at least a time. On the other hand, projects in mature, developed areas do not appear to be likely candidates for delay. Such projects are generally either immediately feasible or never do become feasible. The reason for this relationship is that there is little new construction, and appreciation rates tend towards the growth rate in construction costs. That is, a standard cost-benefit analysis, which evaluates construction of a project in the present period only, is probably adequate for either accepting or rejecting such projects. (Baker-IVI)
W85-03159

**INTERPRETATION OF DOWNHOLE DATA AND DEVELOPMENT OF A CONCEPTUAL MODEL FOR THE REDONDO CREEK AREA OF THE BACA GEOTHERMAL FIELD,**
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
M. A. Grant, S. K. Garg, and T. D. Riney.
Water Resources Research, Vol. 20, No. 10, p 1401-1416, October, 1984. 26 Fig, 34 Ref. US Dept. of Energy contract DE-FC03, 78ET27163.

Descriptors: *Geothermal power, *Redondo Creek, *Wells, *Jemez River, *Baca Geothermal Field, *Paliza Canyon, Carbon dioxide, Reservoirs, Permeability, Thermodynamics.

Available drilling records, downhole surveys, and surface discharge measurements from the wells drilled in the Redondo Creek area through 1981 were examined to determine the depths at which the wells penetrate permeable zones and thereby define those locations at which the pressure/temperature measurements actually correspond to the reservoir conditions. The results of these individual well analyses are used to estimate the initial pressure and temperature distributions of the reservoir system in the Redondo Creek area. This information, together with the well stratigraphy and the zones of fracture permeability penetrated by the wells, is presented on vertical sections across the area. The extent of a two-phase region at the top of the reservoir system is also estimated using the pressure/temperature distributions and the measured carbon dioxide content of the surface discharge from the Baca wells. The conceptual model presented provides the framework needed for detailed reservoir engineering studies. (Baker-IVI)
W85-03164

## 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

**FORECASTING RELATIVE PRICE MOVEMENTS FOR PROJECT EVALUATION,**
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
M. Fortin, and E. McBean.
Water Resources Research, Vol. 20, No. 10, p 1327-1330, October, 1984. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Pricing, *Water resources development, *Evaluation, *Forecasting, *Statistical analysis, Economic aspects, Inflation, Canada.

Inflationary impacts have differentially influenced the prices of various components of water resources projects. Therefore, forecasts based on statistical analyses of historical price trends are examined to determine whether the differential inflationary impacts in the future may be predicted. Forecasts of this type could be valuable in project evaluation exercises if they are reliable. Unfortunately, all of the tests conducted indicate that simple statistical estimates of anticipated rates of change in relative prices are not reliable predictors of future price movements. On average, forcasting errors associated with forecast models that allowed relative prices to vary invariably were higher than errors for a simple forecast that fixed prices to their base year values. Relative price movements should therefore be forecast only on the basis of fairly substantial analyses of market forces. Under such circumstances the value of the price forecasting information must be weighted against the cost of obtaining this information. (Baker-IVI)
W85-03158

## 6D. Water Demand

**WATER-ENERGY LINKAGES IN NEBRASKA,**
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
M. W. Gilliland.
Water Resources Bulletin, Vol. 20, No. 4, p 565-572, August, 1984. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Nebraska, *Energy, *Water resources development, Groundwater, Economic aspects, Irrigation, Water conservation, Conservation, Agriculture, Electric power, Public policy.

Nebraska is well endowed with water, particularly groundwater, but has few fossil fuel reserves. However, it is located adjacent to states which have almost no water but have enormous quantities of coal and oil shale. Recent court cases facilitate the movement of water from water-rich states such as Nebraska to water-short states, such as Colorado and Wyoming. The possibility of an energy-water partnership exists and raises numerous policy questions. Within Nebraska, energy consumption patterns are similar to those of the nation's, with consumption of electricity in the agricultural secter growing fastest. Water consumption in the state is dominated by agriculture, and future development of groundwater for irrigation is expected to be intense. Although water and energy are both factors of economic production, an equivalent amount of water consumption provides more jobs in the energy industries than in agriculture. Water and energy are also interdependent. Each is required to produce the other and conservation of one will cause conservation of the other. If both agriculture and electricity are involved, such as in irrigation, the conservation effects are synergistic. Current water policy in Nebraska is biased toward agriculture relative to the energy industries and provides little incentive for water conservation. Given recent court cases and economic conditions, the advantages and disadvantages of the sale of water for export or the use of water with Wyoming coal energy development need to be compared systematically with those of using water only for agriculture. (Author's abstract)
W85-02983

**RELATIONSHIP BETWEEN COMMERCIAL AND RECREATIONAL USE OF NAVIGATION LOCKS ON THE UPPER MISSISSIPPI RIVER,**
Texas Agricultural Experiment Station, College Station. Dept. of Recreation and Parks.
J. H. Gramann, L. McAvoy Jr., J. D. Absher, and R. J. Burdge.
Water Resources Bulletin, Vol. 20, No. 4, p 577-582, August, 1984. 5 Tab, 14 Ref.

Descriptors: *Locks, *Mississippi River, *Boating, *Barges, Recreation, Navigation, Multiple regression analysis.

Navigation locks on the Upper Mississippi River currently receive heavy use from both commercial barge traffic and recreational craft. Multiple regression analysis of lockage statistics suggests a critical level may exist, below which barge traffic volume has little impact on recreational lock use, but above which it physically constrains recreational lockage. The capacity of the Upper Mississippi River for commercial navigation will be increased by the completion of two new lock chambers at Alton, Illinois. This may adversely impact recreational use of locks by raising commercial traffic levels above the critical level at several other locks on the river. (Author's abstract)
W85-02985

**WATER SUPPLY FOR POWER IN TEXAS-GULF REGION,**
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 3E.
W85-03059

**AVERAGE ANNUAL FULFILLMENT OF INSTREAM USES,**
Kansas Univ., Lawrence. Dept. of Civil Engineering.
R. L. Smith, and W. J. Carswell, Jr.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 497-510, October, 1984. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Instream uses, *Fulfillment, Prediction, Policy, Streams, Flow duration, Plains region, Recreation, Water use.

A significant demand for more formal recognition of instream water use has developed at national, regional, and state levels. This poses the need for a methodology to appraise the relative gains and losses which would arise from the imposition of a given instream use policy. Little prior effort has

been directed toward this goal because of the difficulties involved in quantifying instream benefits. This paper does not attempt to place a dollar value on instream benefits, but does present a procedure for determining the average annual fulfillment of instream use. Case analyses are presented for ten streams which represent a wide range of hydrologic regimes encountered in the plains environment. Predictive functions developed in this study are useful in evaluating the relative instream use potential of different streams. These relations reflect the general shape of flow duration curves experienced in the plains region during the recreational year and the hydraulic characteristics of plains streams. They would not be applicable in regions exhibiting significantly different hydrologic and hydraulic characteristics. (Author's abstract)
W85-03066

**LOCAL OPPOSITION TO THE TRANSFER OF WATER SUPPLIES; AN OKLAHOMA CASE STUDY,**
Oklahoma Univ., Norman. Dept. of Geography.
F. M. Shelley, and C. Wijeyawickrema.
Water Resources Bulletin, Vol. 20, No. 5, p 721-727, October, 1984. 1 Fig, 7 Tab, 15 Ref.

Descriptors: *Lake Tenkiller, *Oklahoma, *Water demand, *Public opinion, Water resources development, Water supply, Water levels, Water transfer, Water management, Decision making.

Interregional conflicts over the allocation and transfer of water supplies have occurred with increasing frequency in the contemporary United States. The results of a case study of citizen opposition to a proposal to transfer water supplies within Oklahoma are presented. A survey was administered to residents of the Lake Tenkiller region who had written letters protesting the City of Tulsa's application to obtain rights to extract water from the reservoir. Survey results indicated that expected effects on water suppy levels were by far the most important negative externality associated with the approval of the application. Effects on the local economy, property values, and recreation were ranked next in importance. The residents of the Tenkiller region appeared to value the maintenance of water levels as important in itself; they proved to be very concerned about the possibility that Tulsa would use too much water and not put the water to appropriate uses. The survey revealed important concern for community interests above and beyond individual self-interest. Effects on the individual and the community were distinguished clearly. The findings support the recently developed concept of turf politics, which suggests that regional and community based considerations tend to dominate interregional locational conflict resolution. (Baker-IVI)
W85-03138

**WATER DEMAND AT WESTERN U.S. RECREATION DEVELOPMENTS,**
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
T. C. Hughes.
Water Resources Bulletin, Vol. 20, No. 5, p 739-746, October, 1984. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Water demand, *Recreational demand, Regional development, Water quality, Water supply, Regulations.

Regulatory agencies in western US generally do not differentiate between water supply design standards for recreation developments and municipal residential and/or hotel requirements. One notable exception is Utah, which specifies quantities for source, storage, and distribution system capacities for three different types of recreation development. While the volume of potable water used at recreation developments is minor relative to total regional water use, very high quality is required and the source is often of limited capacity such as a mountain spring or small local aquifer. Frequent confrontations between developers and regulatory agencies result from claims by developers that water demand will be very small while regulators tend to treat such developments the same as municipal residence. Almost no published data exists for resolving such conflicts. Included in this report are water use measurements of various peak period durations at several types of recreational developments in Utah and Wyoming, statistical analysis of the data and a comparison with municipal demands in the same region, and an analysis of occupancy rates at the various categories of developments. Mountain cabin developers appear to have a point, particularly in regard to seasonal and monthly water use, and to a lesser extent in regard to daily and instantaneous peaks. All of the mountain cabin system peak flows were substantially less than Utah municipal system peaks. Resort condominium developments, particularly time share types with sustained high occupany rates, however, should probably be held to the same criteria as municipal hotels and perhaps even higher criteria are needed where substantial landscaping is irrigated from the potable system. Recreation vehicle campgrounds clearly generate much lower peaks than other recreation systems and should have a separate design standard. (Baker-IVI)
W85-03140

**OGALLALA AQUIFER AND CARBON DIOXIDE: COMPARISON AND CONVERGENCE,**
National Center for Atmospheric Research, Boulder, CO. Environmental and Societal Impacts Group.
M. H. Glantz, and J. H. Ausubel.
Environmental Conservation, Vol. 11, No. 2, p 123-131, Summer, 1984. 1 Fig, 48 Ref.

Descriptors: *Aquifer management, *Carbon dioxide, *Global warming, *Ogallala Aquifer, Water supply, Water demand, Water resources management, Environmental impact, Great Plains.

Agricultural activities in the Great Plains today are highly dependent on water drawn from the underlying Ogallala Aquifer. Yet, there is great concern that the water is being drawn out at rates that far exceed its natural rates of recharge. While the Aquifer's thickness and rates of drawdown differ at different parts of the Great Plains, some regions are already in precarious positions due to the depletion of their portion of the Aquifer. This problem of aquifer sufficiency is examined along with the concern voiced over increasing amounts of carbon dioxide in the atmosphere, resulting in a global warming. The CO2 and the Ogallala issues share several important characteristics. First, the two have in common a long time scale - both are expected to become prominent over about the next 50 years. Both problems have features of a potential tragedy of the commons, such as occurs when a shared resource is exhausted or degraded; both will require widespread action to make most responses effective. To compare possible societal responses to depletion of the Ogallala and CO2-induced climatic changes, categories of response are defined and examples are given. Several strategies are considered including preventive strategies, compensation and adaptation modes. It is important that these two issues be considered jointly as, if present trends in exploitation of the aquifer continue and if speculation about the CO2 issues are correct, these two issues may merge in their effects on society. (Baker-IVI)
W85-03203

## 6E. Water Law and Institutions

**OVERVIEW OF THE US-USSR JOINT AGREEMENT ON ENVIRONMENTAL PROTECTION RELATED TO PREVENTION OF WATER POLLUTION,**
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
W. R. Swain, R. A. Schoettger, N. V. Butorin, and A. M. Nikanorov.
Journal of Great Lakes Research, Vol. 10, No. 3, p 225-228, 1984.

Descriptors: *International agreements, *Ecosystems, *Water pollution prevention, *United States, *USSR, Great Lakes, Lakes, Regulation, Legislation, Standards.

A US-USSR bilateral Agreement on Environmental Protection was signed in 1972. The Prevention of Water Pollution, a part of the larger agreement, is discussed with respect to large lake processes. The organization and infrastructure of this section of the agreement is designed to promote a global environmental ethic. Comparisons of differences in techniques and approaches in dealing with large lake research as determined from the cooperative efforts and resultant scientific papers, has led to improved understanding and has strengthened information bases upon which management decisions are made. Projects which fall into this area of concern must provide a mutually useful outcome and concrete results of significance to aquatic research; undertake work which is scientifically useful, methodologically sound, at the state-of-the-art, and the results of which are scientifically credible; afford opportunities for exchange scientists and researchers which enable the transfer of technology, allow for personal growth, and provide scientific benefit; and function in an atmosphere of honest reciprocity. To date, as a result of the international cooperative efforts, a total of five international symposia have been held, and the proceedings of each have been jointly published in both English and Russian. A total of more than one hundred contributions to new knowledge has resulted from the associated projects. (Baker-IVI)
W85-02881

**SOVIET-AMERICAN COOPERATION IN THE FIELD OF PROTECTING WATER FROM POLLUTION,**
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
N. V. Butorin, and R. A. Schoettger.
Journal of Great Lakes Research, Vol. 1, No. 3, p 229-234, 1984. 27 Ref.

Descriptors: *International agreements, *USSR, *United States, *Water pollution prevention, Regulations, Legislation, Standards.

Anthropogenic effects on aquatic resources in the US and USSR are briefly discussed as a background for the efforts undertaken by participants in Project 02.02-13, The Effect of Pollutants on Aquatic Organisms and Ecosystems: Development of Water Quality Criteria, under the US-USSR Joint Agreement on Environmental Protection. The objectives of this project are to jointly identify pollutants of mutual concern, to exchange information and methodologies, to assess effects of the pollutants on aquatic organisms and ecosystems, and to recommend appropriate water quality criteria. Investigations in progress have focused on toxicity of ammonia in different kinds of receiving systems, effects of organophosphate insecticides, degradation of pollutants by microorganisms, and development of behavioral methods for assessing effects of pollutants on aquatic organisms. Since 1975, the Project has sponsored five joint symposia and has produced nearly 100 scientific publications. This well established exchange of scientific information has familiarized the specialists in both countries with the organization, methods, technical equipment, and results of the work done. It has also enabled proposals to be made for a concept of the organizational aspect of protecting bodies of water from pollution, and of the level and evolution of theoretical treatments, and has yielded some practical results of studies that hold promise for development in the USSR and the USA. (Baker-IVI)
W85-02882

**FLOOD WARNINGS AND FLOOD RESPONSES FOR THE RED RIVER OF THE NORTH,**
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and T. C. Hannan.
Water Resources Bulletin, Vol. 20, No. 4, p 599-610, August, 1984. 5 Fig, 9 Tab, 11 Ref.

Descriptors: *Red River of the North, *Canada, *United States, *Flood forecasting, *Flood warnings, Flood damage, Flood hydrographs, Emergency response.

The valley of the Red River of the North is prone to frequent spring flooding. The relatively long time required for the river flows caused by spring melt to approach peak stages permits a general prediction of flood hydrographs and flood levels several weeks in advance of the actual event. The Red River crosses the boundary between the USA and Canada. While there are some differences in the flood prediction techniques across the border, the major differences in the flooding conditions lie in the actions taken by those exposed to the flood hazard and in the governmental response to the emergency situation. The accuracy of the prediction measures for the major floods in recent history is reviewed, and the differences between the way in which the American and Canadian authorities approach the flood emergencies are outlined. The accuracy of the forecasts are plotted against a number of parameters which reflect the efficiency of the flood fighting measures initiated by those flood forecasts. Due to the centrally co-ordinated reactive nature of the response to the flood forecast in Canada, flood damage reduction measures undertaken the the Canadian portion of the Red River valley may be more effective in reducing overall damages across the whole of the flooded region. The differences in the response to flood warnings also carries over to the post-flood activities, but the differences are not as significant at this stage. No definite relationship between damages averted and accuracy of flood forecast was observed. (Moore-IVI)
W85-02988

## 6F. Nonstructural Alternatives

**STATE WATER CONSERVATION STRATEGIES AND ACTIVITIES,**
Maryland Univ., College Park. Dept. of Geography.
S. W. Sawyer.
Water Resources Bulletin, Vol. 20, No. 5, p 679-685, October, 1984. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Water conservation, *Water management, *Water resources development, Water policy, State jurisdiction.

Strategies used by states to promote water conservation are identified, the status of state conservation activities is reported and the issues and distributions identified are discussed. It is possible to categorize most state efforts into one of four generic approaches or conservation strategies. The agricultural advice network strategy relies on the existing network of agricultural advisory services. In several states water conservation is advanced in public supply systems by requiring them to have formal conservation programs to qualify for state water supply funding programs. This leverage technique is used in Pennsylvania, Massachusetts, Oklahoma, North Carolina and other states. The performance standards strategy is more forceful than leverage incentives in that it sets specific performance requirements for withdrawal and/or consumption reductions. Conservation mandates are the final, most direct strategy identified. Fifteen states currently maintain some form of ongoing water conservation effort. State adoption of specific conservation programs and related variables are displayed to better observe their frequency of use and regional distribution. Specific needs are identified to further advance the cause of water conservation. (Baker-IVI)
W85-03133

## 6G. Ecologic Impact Of Water Development

**FLUCTUATION IN THE ABUNDANCE OF COMMERCIAL FISHES INFLUENCED BY REGULATED RIVER DISCHARGE (AS EXEMPLIFIED BY KUYBYSHEV RESERVOIR),**
Kazan State Univ. (USSR). Dept. of Vertebrate Zoology.
V. A. Kuznetsov.
Journal of Ichthyology, Vol. 20, No. 5, p 32-38, 1980. 3 Fig, 1 Tab, 27 Ref. Translated from Voprossy Ikhtiologii, Vol. 20, No. 5.

Descriptors: *Kuybyshev Reservoir, *Reservoir operation, *Water level, *Fish population, *Population dynamics, Reproduction, Spawning, Fluctuations, Reservoir filling, Environmental effects.

Patterns of fluctuations in abundance during the filling of a reservoir, as exemplified by common fish species in Kuybyshev Resrvoir, are examined. Conditions in reservoirs frequently undergo radical changes as compared with rivers. Pike, blue bream, bream, roach, sichel, white bream, and pike-perch were studied in Kuybyshev Reservoir. The rhythm and range of abundance fluctuations proved to be different in different species of fish during the process of formation of the reservoir. These differences are associated both with the changed environmental conditions, compared with the river, and with the ecological characteristics of these species. The changes in the abundance of fish within the range 30-80% should be considered as showing that a population is capable of adapting to changes in environmental conditions. Higher fluctuation levels, as noted for blue bream and pike, indicate extremely unfavorable conditions for reproduction and to slow adaptation. The food supply, and reproductive conditions are the main factors determining the abundance of populations in a reservoir. Improvement of the conditions of natural reproduction by regulation of the water level regime, improvement of spawning grounds, the creation of regulated spawning grounds and the introduction of protective measures, as well as an increase in natural reproduction, will allow the abundance of species to be regulated and the fish stocks of reservoirs to be used more rationally. (Baker-IVI)
W85-02847

**EFFECT OF DREDGING OPERATIONS IN THE VOLGA RIVER ON MIGRATION OF STURGEON LARVAE,**
All-Union Sturgeon Farming Research Inst., Astrakhan (USSR).
P. V. Veshchev.
Journal of Ichthyology, Vol. 21, No. 5, p 108-112, 1981. 7 Tab, 6 Ref. Translated from Voprossy Ikhtiologii, Vol. 21, No. 5, 1981.

Descriptors: *Dredging, *Volga River, *USSR, *Sturgeon, *Larvae, *Fish migration, Fish management, Fisheries, Fish populations, Environmental effects, Entrainment.

As a result of regulation of the flow of the Volga, the configuration of the stream is changing and shallow water areas are developing creating the need for intensive dredging in the lower course of the river. Sturgeon fry at the first stage of development migrate primarily along the bottom and middle levels of the river. Since most prolarvae migrate along the bottom, the probability of its being trapped in the sucking unit of the dredger undoubtedly increases. In the 8 regions of the Volga studied, the highest larval catches of sturgeons were recorded in the 17 km segment from the Solodikovskiy to Saralevskiy shoals. Over 4 years of study it was determined that 68 to 76.8% of the total larvae caught upstream of the sucking unit are destroyed by the dredging operation. At the first two stations prolarvae of age groups I-II were found in the catches of roe nets. A study of the size and weight parameters of prolarvae in the 8 sections shows that the prolarvae with a length from 4 to 16 mm and weight from 3 to 21 mg and more are trapped in the dredging equipment. This encompasses all the length and weight groups. Considering the brief duration of migration of the sturgeon fry of early age, it was recommended that dredging operations cease for a short period during the spring floods. (Baker-IVI)
W85-02850

**EFFECT OF REGULATION OF THE NILE RIVER ON THE BIOPRODUCTIVITY OF SOUTHEASTERN MEDITERRANEAN SEA,**
Colorado Univ., Boulder.
W. Wadia.
Journal of Ichthyology, Vol. 22, No. 5, p 164-167, 1982. 3 Tab, 11 Ref. Translated from Voprossy Ikhtiologii, Vol, 22, No. 5, 1982.

Descriptors: *Nile River, *Fish, *Mediterranean Sea, *Water resources development, *Aquatic productivity, Phytoplankton, Algae, Phosphates, Nutrients, Environmental effects, River regulation.

The Nile River previously brought a large quantity of dissolved nutrients and organic matter into the Southeastern Mediterranean Sea. Since completion of the Aswan hydrocomplex, reduction in the river flow has caused significant change in the distribution of the physico-chemical indices of the sea water as well as in the formation and distribution of the water masses in the region located north of the Nile delta. In recent years changes have been recorded in the dynamics and distribution of water temperature. From 1966 the sediment runoff of the Nile began dropping sharply due not only to reduction in the volume of river water reaching the sea, but also due to a significant reduction in the suspended particles in the flow. This has had a harmful effect on the formation and dynamics of grounds and banks near the delta and north of it. The reproduction of the shrimp in the area has changed significantly in timing and the food supplies for the young shrimp have deteriorated. Shrimp catches in 1966 were half what they had been in 1963. Commercial fishes have also decreased in numbers. Thus all links of the trophic chain have been affected from the phytoplankton to the pelagic and benthic fishes. (Baker-IVI)
W85-02852

**POTENTIAL IMPACTS OF WATER DIVERSIONS ON FISHERY RESOURCES IN THE GREAT LAKES,**
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
B. A. Manny.
Fisheries, Vol. 9, No. 5, p 19-23, October, 1984. 1 Fig, 2 Tab, 39 Ref.

Descriptors: *Environmental impact, *Diversion losses, *Lake fisheries, *Great Lakes, Lake Michigan, Lake Erie, Welland Canal, St. Clair River, Lake Huron, Lakes, Economic impact, Fisheries, Littoral zone, Wetlands, Alewives, Smelt, Perch.

Uses of Great Lakes water within the Great Lakes basin are steadily increasing, and critical water shortages elsewhere may add to the demands for diversions of water out of the basin in the near future. The impacts of such diversions on fish in the Great Lakes must be considered in the context of in-basin uses of the water, because in-basin uses already adversely affect the fishery resources. Temporary in-basin water withdrawals from Lake Michigan by industry in 1980 equaled 260% of the total volume of water between the shoreline and the 10-meter depth - the littoral waters most heavily used by fish as spawning and nursery grounds. Nearly 100% of the fish removed by these water withdrawals were killed. Enough young alewives (Alosa pseudoharengus) and rainbow smelt (Osmerus mordax) in Lake Michigan and young yellow perch (Perca flavescens) in western Lake Erie have been removed at water intakes in recent years to reduce the productivity and biomass of adult fish stocks. Out-of-basin diversions of water at Chicago and at the Welland Canal, channel modifications in the St. Clair River, and in-basin consumptive water withdrawals have lowered the annual mean water level of Lakes Michigan and Huron by about 27 cm and that of Lake Erie by about 10 cm, dewatering wetlands that historically served as spawning and nursery habitat for many valuable fish species. The dollar value of fish lost to water diversions and withdrawals has not yet been estimated, but water withdrawals alone have already reduced the annual economic impact of the Great Lakes fisheries, which has been estimated to be 1.16 billion dollars. (Author's abstract)
W85-02899

**WATER SUPPLY AND FORESTRY - A CONFLICT OF INTERESTS: CRAY RESERVOIR, A CASE STUDY,**
C. Stretton.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 4, p 323-330, August, 1984. 2 Fig, 3 Tab.

Descriptors: *Land use, *Forestry, *Cray Reservoir, *Wales, *Water pollution sources, Reservoirs, Water quality control, Watersheds, Color, Reservoir operation.

The Cray Reservoir is situated in a glaciated valley in the Brecon Beacons at the head of the river Cray and the dam is 28 m high impounding 4850000 cu m of water at a TWL of 331 m asl. The catchment area of 10.9 sq km and the average annual rainfall of 2146 mm provide a reliable yield of 25 Ml/d, but when the reservoir is full, up to 40 Ml/d are used. Afforestation was begun in March of 1981 with the 36.6 ha Cnewr site which was ploughed and planted. The first indicating of adverse effects of water quality were reported by the reservoir keeper in May of 1981. Discoloration of the Nant Cnewr was evident after heavy rain and contamination of the reservoir was also apparent. The consequences of the developments are all the more serious because much of the distribution area cannot be supplied from an alternative source. The Authority has suffered a significant loss, particularly since management of the reservoir has now slowed the rate of storage recovery and therefore reduced availability of the relatively cheap Cray water. All water systems should list those vulnerable catchments where treatment would be inadequate to cope with significant raw water quality deterioration following land disturbance. This information should be circulated to all parties responsible for the development and control of agricultural land and also to all potential developers. The only solution to the present problems is the provision of a full treatment works. The experience at Cray demonstrates the sensitivity of such direct supply reservoirs to the type of land disturbance that accompanies afforestation. In such circumstances, water supply and forestry cannot coexist, and in future all measures must be applied to divert forestry to those many areas which do not endanger the quality of the public water supply. (Baker-IVI)
W85-03020

**MATHEMATICAL MODEL STUDY OF THE FLUSHING CHARACTERISTICS OF A SHALLOW TIDAL BAY,**
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W85-03052

**EFFECTS OF DIKE CONSTRUCTION ON THE WETLAND ECOSYSTEM ALONG THE FRESHWATER SECTION OF THE ELBE ESTUARY,**
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
C. W. Heckman.
Archiv fur Hydrobiologie, Suppl. 61, No. 4, p 397-508, October, 1984. 23 Fig, 12 Tab, 146 Ref.

Descriptors: *Estuaries, *Haseldorder Marsch, *Wetlands, *Elbe Estuary, *Ecosystems, *Dikes, *Environmental effects, Construction, Tidewater, Aquatic biota, Macroflora, Plankton, Zooplankton, Metals.

Since the completion of a new dike in 1978, a large portion of the Haseldorfer Marsch, an alluvial wetland region along the freshwater section of the Elbe Estuary, has been cut off from tidal influence. The lower lying areas no longer undergo rhythmic periods of exposure and inundation, while the lands at slightly higher elevations are freed from the chance of occasional flooding during storm tides. A total of 348 aquatic and littoral species were observed and identified in the former tidal channels and adjacent water bodies behind the dike, compared with 119 and 286 in habitats that had been exposed to little or no tidal influence before the dike was built and 330 in the estuary and supralittoral marshes that were inundated by seasonal storm tides. Most species adapted to the tidal zone seemed to be at a disadvantage in the competition for the habitat, and some had already been eliminated, while others were relatively rare behind the dike except in the vicinity of the sluice gate, which allowed water from the estuary to pass through the dike at times. Several biotic communities were fully displaced behind the dike. A statistical analysis of benthos samples demonstrated that very heterogeneous distribution patterns prevail. Many terrestrial invertebrate species interact with the marsh community by consuming semiaquatic plants or wetland fungi. A comparison of the water chemistry in each aquatic habitat showed that significant differences already exist between the tidal estuary and the marshes cut off from it by the dike. Dense plant masses exert a strong influence on the diurnal oxygen concentration and pH fluctuations, and this is evident in the curves for the water bodies behind the new dike. Although the number of species inhabiting the waters behind the dike can be expected to increase, the situation is of concern to conservationists because many species specialized to freshwater intertidal habitats have become very rare during the past decades, and the loss of a large part of their remaining range will certainly increase their chances of extinction. (Baker-IVI)
W85-03120

**OXYGEN PRODUCTION IN A BAY WITHIN THE FRESHWATER SECTION OF THE ELBE ESTUARY. AN INVESTIGATION OF THE MUHLENBERGER LOCH IN HAMBURG (DIE SAUERSTOFFPRODUKTION EINER BUCHT IM SUSSWASSERBEREICH DES ELBE-AESTUARS UNTERSUCHUNGEN IM 'MUHLENBERGER LOCH' IN HAMBURG),**
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
H. Caspers.
Archiv fur Hydrobiologie, Suppl. 61, No. 4, p 509-542, October, 1984. 17 Fig, 11 Tab, 12 Ref.

Descriptors: *Water resources development, *Muhlenberger Loch, *Environmental effects, *Oxygen, *Elbe Estuary, Bays, Estuaries.

During periods of extreme oxygen shortages in the Elbe, the temporary supersaturation of oxygen was recorded in a shallow bay with an area of 540 ha called Muehlenberger Loch. Analyses along section lines demonstrated that within distances of less than 1 km, the oxygen concentration can increase from 1 mg/l in the channel to 13 mg/l in the inner region of the bay. The isolines for oxygen concentration approximate the zones of current flow as they move with the tides. The oxygen-poor water reaches only the outer part of the bay with the flood tide. Through mixing with the water there, its oxygen content is increased to about 3 to 4 mg/l. Vertical light measurements showed that the photic zone is limited to the upper 50 to 100 cm. Twenty-four hour exposure periods permitted the calculation of the daily production of oxygen in the photic zone and the oxygen consumption in the aphotic regions. The BOD values decrease in the deeper water layers. The data were used to calculate the oxygen cycle in the bay which shows the bay to be an oxygen donor to the Elbe during the periods in which the oxygen supply is most precarious. Thus the biological value of shallow bays along the estuary to the whole ecosystem is demonstrated. While there had been plans to fill in part of the Muhlenberger Loch to provide land for industry, these plans have been abandoned. An alternate proposal has been made calling for the deepening of Muhlenberger Loch to develop the area for sailing. (Baker-IVI)
W85-03121

# 7. RESOURCES DATA

## 7A. Network Design

**CONSOLIDATION OF A STREAM QUALITY MONITORING NETWORK,**
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier, D. E. Anderson, and R. N. Brenner.
Water Resources Bulletin, Vol. 20, Vol. 4, p 473-481, August, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Water quality, *Monitoring networks, *Streams, *Rivers, *Seattle, *Washington, Monitoring, Network design, Cost analysis.

A method was devised for the consolidation of a stream quality monitoring network, based on the stream network characteristics and a set of station attributes. The approach utilizes a heirarchical structure; stations are allocated to what are termed primary basins on the basis of a weighted attribute score, and specific station locations within each primary basin are specified using a criterion based on stream order numbers. Application of the method to the Municipality of Metropolitan Seattle's routine streams and rivers monitoring network aided in reduction of the network from 81 baseline stations to 47 stations, at a savings of approximately $33,000/yr, exclusive of equipment depreciation and indirect costs. The dynamic program results were used to specify the initial network reduction, which was modified slightly by inclusion of additional, nonquantifiable information such as field personnel judgement, political consideration, and the potential for inclusion of monitoring stations maintained by other agencies. (Moore-IVI)
W85-02973

**SOME PRINCIPLES OF THE STRUCTURE AND ORGANIZATION OF THE HYDROBIOLOGICAL MONITORING OF RIVERS (O NEKOTORYX PRINTSIPAX STRUKTURY I ORGANIZATSII GIDROBIOLOGICHESKOGO MONITORINGA REK),**
J. I. Uzunov, and S. G. Kovachev.
Hydrobiology (Bulgarian Academy of Science), Vol. 21, p 34-41, May, 1984. 2 Fig, 24 Ref.

Descriptors: *Monitoring, *Rivers, *Biological properties, Ecosystems, Environmental effects, Water quality, Networks, Standards.

The biological monitoring should include both background as well as direct impact observations with the former being used as an indicator of the extent of the impact. Otherwise the background monitoring is useless. The two trends of observations should be carried out by comparable methods. Many such methods are available right now but others should be developed as well. The hydrobiological monitoring of rivers in particular should be done on biocenotic level with the implementation of the ecosystems approach. A large network of monitoring stations should be organized which would provide the needed samples annd initial information that would be fed into information-processing device of the administrative and managing unit. This should be scientifically guided by the developing of new criteria, methods and standards. (Author's abstract)
W85-03102

**INTEGRATED GROUND WATER MONITORING PROGRAM USING MULTILEVEL GAS-DRIVEN SAMPLERS AND CONVENTIONAL MONITORING WELLS,**
NUS Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 5A.
W85-03173

**UTILIZATION OF SHALLOW GEOPHYSICAL SENSING AT TWO ABANDONED MUNICIPAL/INDUSTRIAL WASTE LANDFILL ON THE MISSOURI RIVER FLOODPLAIN,**
Ecology and Environment, Inc., Shawnee Mission, KS.
For primary bibliographic entry see Field 5A.
W85-03175

**LONG-TERM CONFIDENCE IN GROUND WATER MONITORING SYSTEMS,**
Hart (Fred C.) Associates, Inc., New York.
For primary bibliographic entry see Field 7B.
W85-03183

## 7B. Data Acquisition

**DETERMINATION OF ALKALINITY AND ACIDITY OF WATER BY CONDUCTOMETRIC ACID-BASE TITRATION,**
National Water Research Inst., Burlington (Ontario).

For primary bibliographic entry see Field 5A.
W85-02734

**MEASUREMENT OF SOIL WATER CONTENT USING A PORTABLE TDR HAND PROBE,**
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
For primary bibliographic entry see Field 2G.
W85-02801

**EFFECTS OF VISITATION FREQUENCY AND INSTRUMENT RELIABILITY ON THE ACCURACY OF ESTIMATION OF RIVER DISCHARGES,**
Iowa Inst. of Hydraulic Research, Iowa City.
For primary bibliographic entry see Field 2E.
W85-02825

**DETERMINATION OF INORGANIC TELLURIUM SPECIES IN NATURAL WATERS,**
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W85-02831

**ION CHROMATOGRAPHIC DETERMINATION OF NITRATE AND SULFATE IN NATURAL WATERS CONTAINING HUMIC SUBSTANCES,**
Lund Univ. (Sweden). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 2K.
W85-02832

**ELECTRICAL METHODS OF DETECTING CONTAMINATED GROUNDWATER AT THE STRINGFELLOW WASTE DISPOSAL SITE, RIVERSIDE COUNTY, CALIFORNIA,**
California Univ., Riverside. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W85-02858

**ELECTRICAL RESISTIVITY INVESTIGATION OF POTENTIAL CAVITIES UNDERLYING A PROPOSED ASH DISPOSAL AREA,**
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W85-02861

**EVALUATION OF SOME NEW TRACERS FOR SOIL WATER STUDIES,**
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2G.
W85-02869

**PREDICTOR-CORRECTOR METHOD FOR MEASUREMENT OF HYDRAULIC CONDUCTIVITY AND MEMBRANE CONDUCTANCE,**
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
For primary bibliographic entry see Field 2G.
W85-02870

**WEIGHING LYSIMETERS FOR LONG-TERM WATER BALANCE INVESTIGATIONS AT REMOTE SITES,**
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2G.
W85-02879

**APPLICATION OF MATHEMATICAL MODELS TO LARGE AQUATIC ECOSYSTEMS,**
Hydrochemical Inst., Rostov-na-Donu (USSR).
For primary bibliographic entry see Field 2A.
W85-02883

**SIMULATION MODELING AS A MEANS OF STUDYING LARGE AQUATIC ECOSYSTEMS,**
Rostovskii-na-Donu Gosudarstvennyi Univ. (USSR). Nauchno-Issledovatel'skii Inst. Mekhaniki i Prikladnoi Matematiki.
For primary bibliographic entry see Field 2A.
W85-02884

**INTERCOMPARISONS OF ANALYTICAL METHODOLOGY AND LABORATORY CAPABILITIES BETWEEN SOVIET AND AMERICAN LABORATORIES - 1973 AND 1977,**
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5A.
W85-02887

**USING HEAT CAPACITY MAPPING MISSION (HCMM) DATA TO ASSESS LAKE WATER QUALITY,**
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W85-02975

**DEVELOPMENT OF EARTH SATELLITE TECHNOLOGY FOR THE TELEMETRY OF HYDROLOGIC DATA,**
Geological Survey, Reston, VA.
R. W. Paulson, and W. G. Shope, Jr.
Water Resources Bulletin, Vol. 20, No. 4, p 611-618, August, 1984. 2 Fig, 11 Ref.

Descriptors: *Satellite technology, *Hydrologic data, Remote sensing, Automation, Telemetry.

The use of satellite telemetry is playing a major role in the collection of hydrologic data. Advancing technology and availability of government satellites have permitted many agencies to take advantage of new procedures for acquiring data from automated remote data collection stations. Experiments with Earth satellite technology started in the 1960's and 1970's, with the polar-orbiting National Aeronautics and Space Administration Nimbus and Landsat satellites. Subsequent advancements took place through the development phase to operational systems using the Geostationary Operational Environmental Satellite (GOES) of the National Oceanic and Atmospheric Administration. This satellite system supports more than 2,500 active telemetry sites, of which approximately 1,200 are Geological Survey stream-gaging stations for the collection of hydrologic data. A satellite data collection system is made up of three primary components; a small battery-operated radio, an Earth-orbiting satellite, and an Earth receive and data processing station. The data relay satellites' vast aerial view of the Earth's surface gives satellite telemetry a large advantage over ground-based systems for the collection of real-time hydrologic data for flood warning, reservoir management, irrigation water control, hydropower generation, and the operation of hydrologic stations. (Author's abstract)
W85-02989

**INEXPENSIVE WEIR AND PROPORTIONAL SAMPLER FOR MINIATURE WATERSHED ECOSYSTEMS,**
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
J. V. Nabholz, D. A. Crossley, Jr., and G. R. Best.
Water Resources Bulletin, Vol. 20, No. 4, p 619-625, August, 1984. 3 Fig, 2 Tab, 19 Ref. DOE contract DE-AS09-76EV00641.

Descriptors: *Weirs, *Samplers, *Small watersheds, Soil-island ecosystems, Water sampling, Rainfall runoff.

Small ecosystems, called soil-island communities, occur in depressions on granitic outcrops. These ecosystems are typically irregularly circular, and only several meters in width. A weir system with a proportional sampler for use on such miniature watershed ecosystems is described. Eight weir collection systems were evaluated for their ability to measure and sample inputs and outputs of soil-island ecosystems. The proportional water samples collected by the weir collection systems were adequate for elemental analysis and provided sufficient data for calculating elemental budgets. Although some of the proportional samples were less than the weir systems were designed to collect, a composite, proportional sample was obtained throughout an entire precipitation event. The greatest danger to sample accuracy is exceeding the capacity of the system. The weir systems were not able to account to 25 to 50% of the variation in total water passing over the cutoff wall. Optimal performance of a proportional sampler occurs when volume of water flow is near maximum rather than near minimum. (Moore-IVI)
W85-02990

**EVALUATION OF TRACER DILUTION TECHNIQUES FOR GAUGING OF RIVERS IN FLOOD,**
Australian Atomic Energy Commission Research Establishment, Sutherland.
For primary bibliographic entry see Field 2E.
W85-03085

**CALIBRATION OF SOIL SURFACE NEUTRON MOISTURE METER,**
For primary bibliographic entry see Field 2G.
W85-03096

**INTERVENTION ANALYSIS OF WATER QUALITY RECORDS,**
Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
P. H. Whitfield, and P. F. Woods.
Water Resources Bulletin, Vol. 20, No. 5, p 657-668, October, 1984. 9 Fig, 4 Tab, 20 Ref.

Descriptors: *Water quality, *Water management, *Kootenai River, *Model studies, Stochastic hydrology, Water resources development.

The use of intervention analysis for statistically describing and modeling streamflow and water quality variables and the effects of impoundment on these variables are discussed. The intervention models were developed with data collected from June 1967 through February 1981 at the two stations on the Kootenai River immediately downstream from Libby Dam. In March 1972 the Kootenai River was impounded by Libby Dam in northwestern Montana to form Lake Koocanusa, a large reservoir operated to provide flood storage, hydroelectric power, and recreation benefits. The water quality of the Kootenai River downstream of the damsite was altered. The alterations are attributable to limnological processes which took place within the reservoir that was created. The application of time series methods, in particular intervention models, allowed the monthly changes in water chemistry to be quantified, and tested for significance. The changes downstream were largely attributable to the depth of withdrawal from the reservoir and the reservoir's ability to store and mix various influent water masses. The preimpoundment and postimpoundment time series of discharge and six water quality variables were autocorrelated and exhibited strong seasonality. (Baker-IVI)
W85-03131

**REMOTE SENSING APPROACH FOR MODELING WATER RESOURCE USE,**
Kansas State Univ., Manhattan. Dept. of Geography.
M. D. Nellis.
Water Resources Bulletin, Vol. 20, No. 5, p 789-793, October, 1984. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Water resources development, *Remote sensing, *Irrigation, Water use, Leakage, Seepage, Reservoirs, Canals, Comsumptive use.

Remote sensing data combined with other spatially referenced data were used to predict water resource use in an irrigated area of Central Oregon. Crop type and irrigation method were determined using color infrared aerial photography and thermal infrared imagery, respectively. These data were combined with crop consumptive use and

irrigation method application efficiency values to determine total water applied to a transect sample through the heart of the study area. This information, when integrated with data on canal leakage and storage reservoir seepage, allowed the researcher to predict total water use for the entire management unit. The model developed was accurate at a level of 92.0%. The approach outlined can be repeatable, practical and cost-effective throughout irrigated areas of the Western United States. With projected increase in irrigated areas throughout the arid Western United States and the frequent lack of water resource use information, remote sensing data, when combined with other data inputs, can provide water managers with critical statistics on total water use. Such information, when combined with institutional and economic variables can increase the resource manager's ability to make wise management decisions. (Baker-IVI)
W85-03145

**FLOW-THROUGH MICROCUVETTE FOR FLUOROMETRIC DETERMINATION OF CHLOROPHYLL,**
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
M. F. Knowlton.
Water Resources Bulletin, Vol. 20, No. 5, p 795-799, October, 1984. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Measuring instruments, *Chlorophyll, *Fluorometers, *Microcuvettes, Water analysis, Water quality control, Cuvettes.

A flow-through microcuvette is described for determination of chlorophyll with the Turner Designs model 10 fluorometer. The device approximately doubles the speed of repetitive chlorophyll determinations. With a single- standard calibration procedure, chlorophyll concentrations in the approximate range of 0.01-2.0 microg/mL can be determined with a relative error of less than 3%. Coupled with the use of extraction techniques which remove the need for grinding sample filters, use of an FTM-equipped fluorometer and the procedures outlined here can minimize the time and effort required for precise determination of chlorophyll. Adoption of these techniques can be of great advantage to those engaged in routine analysis of large numbers of chlorophyll samples. (Baker-IVI)
W85-03146

**COMPUTING DRAWDOWN DISTRIBUTION USING MICROCOMPUTERS,**
GAI Consultants, Inc., Monroeville, PA.
For primary bibliographic entry see Field 2F.
W85-03157

**INNOVATIVE SAMPLING TECHNIQUES FOR GROUND WATER MONITORING AT HAZARDOUS WASTE SITES,**
CH2M Hill, Inc., Gainesville, FL.
T. C. Emenhiser, and U. P. Singh.
Ground Water Monitoring Review, Vol. 4, No. 4, p 35-37, Fall, 1984. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Monitoring, *Groundwater, *Sampling, Measuring instruments, Water pollution control.

Several innovative techniques have been employed for sampling ground water quality at hazardous waste sites. One sampling technique involved the use of the new ISCO Model 2600 submersible portable well sampling pump. A compressed air source forces water from the well into the pump casing and then delivers it to the surface through a pulsating action. This pump was used in wells that could not be sampled with surface lift devices. Another sampling technique involved the use of a Teflon manifold sampling device. The manifold is inserted into the top of the sampling bottle and a peristaltic pump creates a vacuum to draw the water sample from the well into the bottle. The major advantage of this technique for these conditions is the direct delivery of the water sample into the collection container, reducing the potential for contamination. These sampling techniques are successful in reducing cross-contamination between monitoring wells. Analysis of field blanks using organic-free water in contact with these sampling devices did not show any concentration at or above the method detection limit for each priority pollutant. (Baker-IVI)
W85-03171

**PORTABLE WELL POINT SAMPLER FOR PLUME TRACKING,**
W. B. Kerfoot.
Ground Water Monitoring Review, Vol. 4, No. 4, p 38-42, Fall, 1984. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Sampling, *Water analysis, *Groundwater, Cost analysis, Economic aspects, Plumes.

A shallow well point sampler can provide cost-effective sampling of contaminant plumes for regions of shallow groundwater. A miniature well point sampler allows rapid sampling of groundwater down to a maximum depth of 12 ft below grade. A high ratio of striking force to cross-sectional area of the shaft enables the well point to penetrate soils grading from silt through sand to fine gravel. Three slot sizes have proved satisfactory for the slotted well point. For fine gravel through silty sand, a receiver flask serving as a silt trap with a hand pump can withdraw water samples. For silt or clay, a special shielded point is used to expose a porous screen upon withdrawal of the shaft. The points can be left imbedded in the strata and a vacuum drawn to recover a sample under saturated or unsaturated conditions. The probe has been used in dye studies with conductivity meters and fluorometers for profiling subsurface plumes. A cost comparison is shown between monitoring well installation and the portable well point for varying sample frequency and depth. The cost of investigation is usually one-fourth to one-fifth that of small diameter well installation. The low purge volume and degree of isolation of the points during sampling avoid dilution interferences commonly encountered in monitoring wells. (Baker-IVI)
W85-03172

**SUCTION SIDE SAMPLE CATCHER IN GROUND WATER QUALITY SAMPLING,**
McLaren Environmental Engineering, Inc., Sacramento, CA.
For primary bibliographic entry see Field 5A.
W85-03174

**SPATIAL MAPPING OF CONDUCTIVE GROUND WATER CONTAMINATION WITH ELECTROMAGNETIC INDUCTION,**
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W85-03177

**APPLICATION OF COMBINED SEISMIC AND ELECTRICAL MEASUREMENTS TO THE DETERMINATION OF THE HYDRAULIC CONDUCTIVITY OF A LAKE BED,**
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
R. W. Taylor, and D. S. Cherkauer.
Ground Water Monitoring Review, Vol. 4, No.4, p 78-85, Fall, 1984. 12 Fig, 22 Ref.

Descriptors: *Groundwater, *Monitoring, *lake beds, *Hydraulic properties, Groundwater flow, Permeability.

The hydraulic properties of lake beds control the interactions between lakes and ground water systems, but these properties are normally difficult to measure directly. The method presented combines seismic reflection and electrical measurements to map the relative hydraulic conductivity of lake bed sediments. A shipboard seismic profiling system provides sediment thickness, while a towed electrical array yields longitudinal conductance and electrical chargeability. The procedure and systems have been used to map the bed of Lake Michigan offshore from an area of heavy pumpage. Mapping these plumes onshore permits the inference of the spatial distribution of offshore hydraulic conductivities. Offshore seepage measurements and numerical, chemical transport modeling of this site have confirmed the reliability of the geophysically derived hydraulic conductivities and have also demonstrated the improvement in numerical results achieved through the availability of spatially determined hydraulic conductivities. (Baker-IVI)
W85-03178

**MONITORING HYDROGEOLOGICAL CONDITIONS IN FRACTURED ROCK AT THE SITE OF CANADA'S UNDERGROUND RESEARCH LABORATORY,**
Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
For primary bibliographic entry see Field 8E.
W85-03180

**GROUND WATER INSTRUMENTATION PROGRAM OF THE U.S. GEOLOGICAL SURVEY,**
Geological Survey, NSTL Station, MS. Hydrologic Instrumentation Facility.
E. H. Cordes.
Ground Water Monitoring Review, Vol. 4, No. 4, p 103-114, Fall, 1984. 15 Fig, 3 Ref.

Descriptors: *Measuring instruments, *Groundwater, *Monitoring, Flowmeters, Pumps, Groundwater flow, Water sampling.

A variety of ground water data collection and sampling programs have been carried out over the years by the US Geological Survey. The use of commercial and industrial equipment in these studies is often precluded due to constraints imposed by logistics and the environment. In house design and development of selected instruments has been commonplace as well as modifying already existing equipment to fit the specific need involved. Groundwater instrumentation currently being designed and developed includes running time totalizer, cross-correlation pipe flowmeter, ground water monitoring system, and a small diameter deep well pump. Each of these developments is described and their principles of operation are presented. (Baker-IVI)
W85-03181

**TECHNIQUES AND EQUIPMENT USED IN CONTAMINANT DETECTION AT HOE CREEK UNDERGROUND COAL GASIFICATION EXPERIMENTAL SITE,**
University of Wyoming Research Corp., Laramie. Western Research Inst.
S. C. Davidson, E. M. McTernan, and R. G. Kunzel.
Ground Water Monitoring Review, Vol. 4, No. 4, p 115-118, Fall, 1984. 4 Fig, 5 Ref.

Descriptors: *Groundwater, *Monitoring, *Wells, *Hoe Creek Coal Gasification Plant, *Wyoming, *Powder River Basin, Coal gasification, Plumes, Groundwater pollution.

Twenty new monitoring wells were drilled at the Hoe Creek Underground Coal Gasification site. The final locations of the wells were determined by taking a water sample for the hole after it was drilled and field analyzing the sample for total phenol. Three aquifers were monitored in each well by using multiple well completion techniques with gas-drive sampler/piezometers. The location for each sampler piezometer was determined using electric logs. These logs were also used to obtain a more accurate picture of the site geology. The techniques and equipment used in this project have successfully delineated the contamination plume on the east, south and west sides of the three UCG burns. The limit of contamination to the north has not been defined because offsite drilling was required and permission from the landowner had not been obtained. It is anticipated that further work will be conducted to estimate the northern limit of the contaminant plume. (Baker-IVI)
W85-03182

**LONG-TERM CONFIDENCE IN GROUND WATER MONITORING SYSTEMS,**

Hart (Fred C.) Associates, Inc., New York.
J. A. Perazzo, R. C. Dorrler, and J. P. Mack.
Ground Water Monitoring Review, Vol. 4, No. 4, p 119-123, Fall, 1984. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Groundwater, *Monitoring, *Equipment, Measuring instruments, Water quality control, Wells.

The degree of confidence placed in the analytical data from a ground water monitoring system necessitates that the system is carefully designed and constructed. A thorough understanding of the geologic and hydrogeologic settings and the geochemical properties of the natural and/or contaminated ground water are essential elements to be considered in the design of a monitoring system. Once installed, a monitoring system should be periodically maintained and inspected to ensure that the wells are in hydraulic connection with the monitored zone and no obvious physical defects in the grout seal or well casing have occurred. When the integrity of the monitoring system beomes suspect, a more detailed inspection using downhole television cameras may confirm specific problems with the well casing. If certain problems are identified, abandonment of the monitoring system may be the most viable option. The common goal of all abandonment techniques is to place a competent grout seal throughout the borehole. Several alternative abandonment methodologies have been identified. The most suitable abandonment technique depends primarily on the type of well construction. An inspection and investigation of an existing monitoring system at a hazardous waste disposal facility was undertaken. The findings of this inspection and investigation indicate that the monitoring wells were providing pathways for contaminant migration as a result of construction techniques, installation techniques and physical defects in the well casing materials. Subsequently, an appropriate abandonment program was designed and implemented. This program involved the in place destruction of the monitoring wells while preventing contaminants from migrating during the abandonment process and after the well was removed by ensuring the re-drilled borehole was completely sealed. (Baker-IVI)
W85-03183

**APPLICATION OF TELEMETRY TO LARGE-SCALE HORIZONTAL ANISOTROPIC PERMEABILITY DETERMINATIONS BY SURFACE TILTMETER SURVEY,**
Permeability, Inc., Orinda, CA.
W. W. Loo, K. Franz, and G. R. Holzhausen.
Ground Water Monitoring Review, Vol. 4, No. 4, p 124-130, Fall, 1984. 10 Fig, 12 Ref.

Descriptors: *Groundwater, *Monitoring, *Measuring instruments, *Tiltmeters, *Telemetry, Permeability, Groundwater movement, Anisotropy.

The application of telemetry to large-scale horizontal anisotropic permeability by surface tiltmeter suveys can provide the following improvements on conventional pump test analysis. Only one pumping well and one observation well are needed with an array of 8 to 10 tiltmeter monitoring stations. Real-time analysis is provided of horizontal anisotropic permeability or heterogeneity of the aquifer system as the pressure decline cone expands. Hydraulic test depth range may effectively extend to 4,000 feet in a cost effective manner. Improved versatility and flexibility of data acquisition by two way radio links will result. A thorough understanding of the geology overlying the aquifer system must be made in order to assess the applicability of the surface tiltmeter survey to large-scale horizontal anisotropic permeability. (Baker-IVI)
W85-03184

**NEW SYSTEM FOR GROUND WATER MONITORING,**
BAT Envitech A.B., Stockholm (Sweden).
B.-A. Torstensson.
Ground Water Monitoring Review, Vol. 4, No. 4, p 131-138, Fall, 1984. 13 Fig, 1 Tab, 6 Ref.

Descriptors: *Groundwater, *Monitoring, *Measuring instruments, Pore water, Water pressure, Permeability, Groundwater flow, Groundwater movement.

A new system is described for ground water monitoring, called the BAT system, which includes the following functions: sampling of ground water in most types of soils, measurement of pore water pressure, and in situ measurement of hydraulic conductivity. The system can also be used for tracer tests. A permanently installed filter tip is used attached to a steel or PVC pipe. In most cases installation is performed by pushing the tip down to the desired depth. The filter tip can also be buried beneath a landfill. The primary feature of the new system is that the filter tip contains a self-sealing quick coupling unit, which makes it possible to temporarily connect the filter tip to adapters for various functions. Water sampling and measurements of pore pressure and hydraulic conductivity are some of these functions. Sampling of both pressurized water and gas is possible with the new technique. Samples are obtained directly in hermetically sealed, pre-sterilized sample cylinders. Sampling of ground water and measurement of pore pressure can be repeated over a long period of time with undiminished accuracy. Water samples can also be taken from different strata in a soil profile, in both the saturated and unsaturated zones. Actual installations range from 0.5 to 60 m depth. (Baker-IVI)
W85-03185

**SIMPLE PNEUMATIC DEVICE AND TECHNIQUE FOR PERFORMING RISING WATER LEVEL SLUG TESTS,**
Purdue Univ., Lafayette, IN.
D. I. Leap.
Ground Water Monitoring Review, Vol. 4, No. 4, p 141-146, Fall, 1984. 4 Fig, 8 Ref.

Descriptors: *Groundwater, *Monitoring, *Transmissivity, Wells, Aquifer characteristics, Groundwater level.

A pneumatic water level depressor can be built quite inexpensively for about $500 from off-the-shelf items. It provides a method of making water level recovery tests for transmissivity in wells without having to inject water or bail it out or to displace it with a dead weight. More sophistication can be obtained by use of a pressure transducer and strip chart recorder or data logger to detect and record water level changes, but the device described is much less expensive and does not require calibration before each test as does the transducer. In addition, there is the advantage of rugged durability. The simplicity of the device is advantageous in rugged field conditions because it has few sophisticated parts to break down. Field repairs are quite easy and replacement parts can usually be obtained from a local hardware store or machine shop. Plots of head recovery in the well as a function of time can be used to estimate transmissivity by three well-established methods. (Baker-IVI)
W85-03186

**DESIGN AND IMPLEMENTATION OF EVAPOTRANSPIRATION MEASURING EQUIPMENT FOR OWENS VALLEY, CALIFORNIA,**
For primary bibliographic entry see Field 2D.
W85-03188

**SURFACE AND BOREHOLE GEOPHYSICAL METHODS IN GROUND WATER INVESTIGATIONS,**
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 2F.
W85-03189

**APPLICATION OF TELEVISION BOREHOLE LOGGING TO GROUND WATER MONITORING PROGRAMS,**
Hart (Fred C.) Associates, Inc., New York.
For primary bibliographic entry see Field 2F.
W85-03190

**STATE-OF-THE-ART APPROACH TO HYDROLOGIC DATA MANAGEMENT,**
Insitu Consulting, Laramie, WY.
S. C. Way, H. K. Wainwright, and W. P. Ward.
Ground Water Monitoring Review, Vol. 4, No. 4, p 179-182, Fall, 1984. 5 Fig, 2 Tab.

Descriptors: *Measuring instruments, *Water level, *Hydrologic data, *Automation, Data management, Groundwater, Monitoring, Pump testing, Slug tests, Computers.

High-accuracy electronic data acquisition equipment, a solid-state memory, computer interface and software have been developed to provide a complete system for measuring and recording water level changes. A small, stand alone hydrologic instrument, the SE1000, provides the automation and accuracy of solid-state electronics in pump tests, slug tests, and long and short term groundwater monitoring. The unit is powered by a high performance battery pack with a minimum life of four years. This instrument can be buried at the monitoring site for protection from vandals, animals and temperature extremes. Ten pre-programmed 949-point data schedules are standard. One schedule is logarithmic with an initial data interval of 0.2 seconds. Nine linear schedules provide data intervals ranging from 15 minutes to 1.5 days and corresponding test durations ranging from 10 days to 46 months. The stored data can be recovered directly via the LCD display or transferred to a computer. Software provides automatic data reduction with hard copy tables and plots. The SE1000 has been used successfully for data collection in a number of capacities. One example of its use involved the measuring and recording of water levels in a Parshal flume at a remote site in Utah, approximately 10,000 feet above sea level. The instrument was installed in the fall of 1982, as field conditions permitted, and left there to collect data, unattended, during the following spring. At another site, in Wyoming, slug tests were performed on a number of existing stock wells to determine the range of transmissivity values over a large area. (Baker-IVI)
W85-03191

**MONITORING IN THE VADOSE AND SATURATED ZONES UTILIZING FLUOROPLASTIC,**
Timco Mfg., Inc., Prairie du Sac, WI.
T. Fishbaugh.
Ground Water Monitoring Review, Vol. 4, No. 4, p 183-187, Fall, 1984. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Lysimeters, *Groundwater, *Monitoring, *Fluoroplastic, Vadose zone, Saturated zone, Filter materials.

The development of the sleeve lysimeter has alleviated many of the problems involved in monitoring the saturated/unsaturated zone. With the sleeve lysimeter attached directly to the casing string, correlation problems between the zones are eliminated. Installation time is reduced because the entire system is installed at the same time and because the number of seals and conductor pipes is at a minimum. The sleeve lysimeter's threaded design enables the other components of the monitoring well to be variable in design and construction. This affords a monitoring well suited for the soil characteristics and contamination present and also allows the design to have more flexibility with costs. It should be emphasized that savings in initial installation costs can be misleading in the overall long-term monitoring program. The development of the Teflon lysimeter and monitoring well has made it possible to install a totally inert monitoring system; a system in which the materials used in construction do not interfere with the integrity of the well or the samples withdrawn. (Baker-IVI)
W85-03192

## 7C. Evaluation, Processing and Publication

**STANDARD HYDROLOGIC EXCHANGE FORMAT (SHEF),**

National Weather Service, Portland, OR. Northwest River Forecast Center.
V. C. Bissel, P. A. Pasteris, and D. G. Bennett.
Journal of Water Resources Planning and Management, Vol. 110, No. 4, p 392-401, October, 1984. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Standard Hydrologic Exchange Format, *Data processing, *Hydrologic data, *Meteorological data, Data transmission, Automation.

The Standard Hydrologic Exchange Format (SHEF) has been developed jointly by the National Weather Service (NWS) and by the Corps of Engineers North Pacific Division for use in the interagency Columbia River Operational Hydromet Management System (CROHMS). SHEF features include: (1) Readability by both man and machine; (2) two characters to describe most hydrometeorological parameters; (3) internal data base identification of observational data, processed products, and forecasts; (4) time identification in either local or Greenwich meridian time systems; (5) identification of data from non-standard locations; (6) optional special data descriptors to individual data values; (7) three different format structures to allow coding one-station-per-line, several lines with common data elements indicated by a header line, and lines of evenly time spaced data strings; (8) flexibility in use of spaces and comments within code text to enhance readability; and (9) ease of use in either English or SI units. The SHEF code holds great potential for easing automated exchanges of operational hydrometeorological data among a wide variety of agencies and reducing the multiplicity of data-receiving software typical of many broad-scale operations. (Author's abstract)
W85-03060

# 8. ENGINEERING WORKS

## 8A. Structures

**GROUTING REHABS EARTH DAM,**
GKN Hayward Baker Co., Odenton, MD.
W. H. Baker, H. N. Gazaway, and G. Kautzmann.
Civil Engineering, Vol. 54, No. 9, p 49-52, September, 1984. 4 Fig, 1 Tab.

Descriptors: *Earth dams, *Rehabilitation, *Grouting, Dam construction, Powerplants, Storage basins, Acrylate, Cement, Fly ash.

The following crucial steps were required for the cutoff grout curtain rehab: careful, detailed subsurface investigation and work planning; cased-hole drilling to protect the embankment materials from hydraulic fracturing due to drilling fluid pressures; low-pressure, short duration water testing to assist in type selection of grout; field selection of grout types, on a hole-by-hole basis, between stable cement-based grouts for high water-take zones and rapid-setting, low-viscosity acrylate groups for the lower water-take zones; high-speed shear mixing of low water:cement or water:solids ratio grouts to produce a stable grout mix with excellent groutability; continuous mixing injection of controlling gel time, acrylate grout for pumping times longer than gel times; injection under low pressures of selected grout type in split-spaced borehole pattern, with at least secondary holes and tertiary holes in high take areas; careful monitoring of injection pressures and flow rates to detect embankment fracturing; and piezometer monitoring of before- and after-grouting water levels within the dam embankment and foundation. These were the steps used in rehabing an earthfill dam for a storage basin at a Pennsylvania powerplant. The implementation of the cement/fly ash and acrylate chemical grouting program is described. (Baker-IVI)
W85-02728

**YANGTZE ENGINEERS AIM HIGH.**
For primary bibliographic entry see Field 6B.
W85-02753

**WHY NOT HERE - AN ENGINEER LOOKS AT INLAND WATERWAY TRANSPORT,**
Imperial Coll. of Science and Technology, London (England).
M. Baldwin.
Proceedings of the Institution of Civil Engineers, Vol. 76, Part 1, p 601-613, August, 1984. 10 Tab, 31 Ref.

Descriptors: *Transportation, *Canals, *Great Britain, *Inland waterways, Planning, Waterways, Civil engineering.

It is often popularly supposed that the development of waterway engineering in Britain came to an end with the onset of the railway age. The careers of L. F. Vernon-Harcourt, Sir Edward Leader Williams, William Bartholomew and John Saner, all of whom started work in the period 1840-1880, show that this is not the case, although it remains true that there has been little important development this century. In contrast, in may other industrialized countries innovative engineering has been essential to allow waterways to remain competitive in the freight transport market. Why do so many other nations make far greater use of this mode than the UK does. Before answering this, the important features of inland waterway transport must be identified. These include the absence of monopolistic operation, and the large capacity and low operating costs of the craft. No intrinsic technical factor explains the low level of use of waterways in Britain, nor does the topography. Instead, the answer lies in our system of planning and financing transport. The removal of existing anomalies would not only give industry access to cheap transport, with minimum environmental disturbance, but also provide the associated benefits of water distribution, and leisure use. (Author's abstract)
W85-02947

**NEW PORT OF SAPELE, NIGERIA,**
P. W. Ediale, J. G. Logie, and J. W. Alexander.
Proceedings of the Institution of Civil Engineers, Part 1, Vol. 76, p 615-634, 1984. 11 Fig, 3 Ref, 4 Append.

Descriptors: *Construction, *Design criteria, *Port facilities, *Sapele, *Nigeria, Planning, Management, Decision making, Contracts.

The program of development of the ports in Nigeria during the past 25 years is reviewed. Particular attention is given to the role of the Port of Sapele. Sapele is situated on the Benin River and is approached from the sea by entering the Escravos River and through the Nana Creek to join the Benin River. The contract negotiations for the port are described leading to the start of construction in July 1980. The port has a quay length of 1150 m, the quay having a composite schedule of facilities including a unique combined water and control tower. Construction problems are discussed including methods adopted to create the port of Sapele out of virgin forest in a period of 18 months. Details are provided concerning soils investigation studies, dredging and reclamation works, pilings, the control/water tower, buildings and structures, concrete pavements, materials and workmanship, and staff. The port of Sapele was commissioned on 1 May 1982, from which date the port has been in operation. (Baker-IVI)
W85-02948

**REINFORCEMENT CORROSION AND THE DURABILITY OF CONCRETE BRIDGES,**
Transport and Road Research Lab., Crowthorne (England).
P. Vassie.
Proceedings of the Institution of Civil Engineers, Vol. 76, Part 1, p 713-723, August, 1984. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Bridges, *Concrete construction, *Corrosion control, *Reinforced concrete, Bridge design, Salts, Chloride, Cathodes, Asphalt.

Corrosion can arise in most parts of a bridge substructure or superstructure and usually results from the use of de-icing salts. Substructure corrosion is often associated with leaking joints, faulty drainage or salt spray from traffic. General corrosion is found on substructures and although this is a relatively slow process, producing only small reductions in bar cross-section, it causes substantial disruption of the concrete cover. Localized corrosion has occurred on unwaterproofed decks and is much more rapid than general corrosion; it lead to substantial local reductions in bar cross-section. This form of corrosion is not easy to detect visually because it is not always associated with concrete disruption or rust staining and, in any event, the deck is covered with asphalt surfacing. Several site investigation tests are available. When used together they can usually locate corroding reinforcement, determine its type and causes and estimate its rate, thus providing the information required to specify repairs. The threshold concentration of chlorides in concrete bridges of 0.35% has not proved a reliable basis for predicting corrosion. Likely explanations are that chloride contamination is associated with relatively high concentrations of the more-damaging free chloride ion. Localized anodes also sometimes protect the surrounding steel from effects of high chloride levels. The repair of chloride-contaminated bridges is difficult. Repair of corroding areas is generally effective, but the development of anodes in the concrete adjacent to the repair can lead to further damage. Cathodic protection appears to be the most promising method of overcoming this problem, although further development is needed before it can be applied effectively. (Author's abstract)
W85-02950

**HYDROECOLOGY OF THE GRASS-ASSOCIATIONS FOUND AT THE DAMS ALONG THE UPPER-TISZA,**
Jozsef Attila Univ., Szeged (Hungary). Dept. of Botany.
For primary bibliographic entry see Field 2I.
W85-03118

**DESIGN FOR A STABLE CHANNEL IN COARSE ALLUVIUM FOR RIPARIAN ZONE RESTORATION,**
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 2E.
W85-03135

## 8B. Hydraulics

**BOUNDARY EFFECTS ON A SUBMERGED JET GROUP,**
Hong Kong Univ. Dept. of Civil Engineering.
J. H. W. Lee.
Journal of Hydraulic Research, Vol. 22, No. 4, p 199-216. 9 Fig, 2 Tab, 10 Ref.

Descriptors: *Boundary effects, *Jets, *Model studies, *Boundary conditions, Hydraulics, Mixing, Hydraulic models.

A vortex model was employed to calculate the flow induced by a line group of submerged high velocity shallow water jets discharging in proximity to a shoreline boundary. Based on an inviscid flow model, kinematic and dynamic boundary conditions were formulated along the unknown lines of velocity discontinuity downstream of the multiple jets. This resulted in two governing nonlinear integral equations in terms of the unknown circulation strength along the unknown slipstream lines. The numerically computed two dimensional momentum-induced flow showed that, as the jet group is placed closer to the boundary, the contraction of the slipstream becomes stronger, resulting in a decrease of the induced flow. All of the features predicted by the theory are in good agreement with experimental results of this and previous investigations. (Author's abstract)
W85-02952

**SCOUR DUE TO RIPRAP AND IMPROPER FILTERS,**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Koloseus.

Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1315-1324, October, 1984. 5 Fig, 4 Ref, 1 Append.

Descriptors: *Scour, *Riprap, *Filters, Piezometric gradients, Hydraulic structures, Water level, Pressure, Ponding, Rainfall runoff, Irrigation effects.

Frequently, an alluvial channel immediately downstream of a hydraulic structure shows signs of scour even though the channel appears to be otherwise in equilibrium and even though the channel is heavily riprapped just downstream from the structure. Differences in water level between various parts of a hydraulic structure could give rise to negative piezometric gradients which might result in excessive scour in the vicinity of the structure. Riprap can have a tendency to magnify piezometric gradients at the bed of a channel thereby enhancing the leaching potential of the gradients. Riprap might also bring about elevated pressures which have a tendency to dislodge the riprap. Riprap will not give rise to magnified gradients or elevated pressures if proper use is made of filters and high permeability drainage layers. Erratic channel scour may be due to temporal changes in piezometric gradients which are brought about by such natural occurrences as ponding of water, rainfall, and irrigation. (Moore-IVI)
W85-03005

**COMPUTATION OF DYNAMIC WAVES IN CHANNEL NETWORKS,**
I. B. Joliffe.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1358-1370, October, 1984. 3 Fig, 1 Tab, 13 Ref, 1 Append.

Descriptors: *Channel networks, *Dynamic waves, Mathematical models, Computers, Simulation, Sparse matrix technique.

A numerical model was developed for simulating flows in either looped or dendritic channel networks. Analytic differentiation is used to evaluate the partial derivative terms in the linear equations that are used to calculate the flow corrections. A sparse matrix technique is used to store and solve the partial derivative terms. The model has the same convergence and stability characteristics as when numerical differentiation is applied to a single channel propagation problem. Simulations of flows in channel networks showed the proposed model to require a much smaller quantity of computer memory than an alternate model formulated without using the sparse matrix solution technique. The same numerical experiments showed the model to be computationally efficient, requiring small amounts of computational time for network simulations. (Moore-IVI)
W85-03007

**INITIAL TRANSIENTS IN LONG WAVE COMPUTATIONS,**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Civil and Systems Engineering.
L. Bode, and R. J. Sobey.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1371-1397, October, 1984. 11 Fig, 15 Ref, 2 Append.

Descriptors: *Long wave, *Mathematical equations, *Initial transients, Hydrodynamics, Coastal areas, Forcing, Channels, Estuaries, Friction, Boundary conditions.

The shallow water or long wave equations provide a successful predictive capability for a number of important flow problems in coastal hydrodynamics. The generation of initial transients in long wave computations has been traced to the incompatibility between the initial conditions and the forced response at zero time. Their origin is physical, not numerical. They are free mode responses; they are unwanted and cannot be avoided, but they can be accomodated. The character of the initial transients is described in the context of numerical solutions to a typical estuary and a typical channel problem and in the context of an analytical solution to the linearized equations for a prismatic channel. Strategies to avoid initial transients are investigated in detail, in particular, initially-enhanced friction, the gradual introduction of forcing and various radiation boundary conditions. A modified Reid radiation boundary condition provides a gradual transition back to the correct one point boundary conditions and to the correct forced response, but taking advantage initially of the efficiency of the Reid condition in eliminating the free modes. This approach is quite successful and suitable for general aplication, supplemented where necessary by the gradual introduction of the forcing over part or all of the transition period. (Moore-IVI)
W85-03008

**REGULAR MEANDER PATH MODEL,**
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1398-1411, October, 1984. 6 Fig, 23 Ref, 1 Append. NSF grant CEE-8209029.

Descriptors: *Meanders, *River flow, *Transverse circulation, Wave length, Channel roughness, Curvature, Channel morphology.

River flow in a meandering channel is characterized by the growth and decay of the transverse circulation which reaches a maximum near the apex and reverses its direction near the crossover. Based upon the mechanics of flow governing the spatial variation of transverse circulation, a mathematical model for regular meander paths is developed. For a specified arc angle or channel curvature at the apex, this model provides the shape as well as the scale of the meander path, from which other planimetric parameters such as arc length, wave length, and amplitude can be directly obtained. The arc length-depth ratio is found to be an inverse function of channel roughness. A meander bend is constrained by a maximum curvature that it may develop under the state of equilibrium. Under such a curvature, the wave length-depth ratio is directly related to channel width-depth ratio and inversely related to channel roughness. (Author's abstract)
W85-03009

**BOUNDARY SHEAR IN SYMMETRICAL COMPOUND CHANNELS,**
Birmingham Univ. (England). Dept. of Civil Engineering.
D. W. Knight, and M. E. Hamed.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1412-1430, October, 1984. 12 Fig, 5 Tab, 39 Ref, 1 Append.

Descriptors: *Shear stress, *Shear force, *Boundary shear, *Channel morphology, Flood plains, Roughness, Mathematical equations, Model studies, Momentum, Velocity, Flow discharge.

Experimental results are presented concerning the boundary shear stress and boundary shear force distributions in a compound section comprising of one rectangular main channel and two symmetrically disposed flood plains. The flood plains were roughened progressively in six steps so that the influence of differential roughness between the flood plains and the main channel on the lateral momentum transfer process could be studied. For the maximum applied roughness, the widths of the flood plains were then reduced. Equations are presented giving the shear force on the flood as a percentage of the total shear force in terms of four dimensionless parameters. Supplementary equations are also presented giving the apparent shear forces on vertical, inclined and horizontal interfaces within the cross section. The influence of momentum transfer between sub areas on the vertical and lateral distribution of longitudinal velocity is also assessed. The discharge and apparent shear force results reveal certain weaknesses in four commonly adopted methods used to predict the discharge capacity of compound channels. (Author's abstract)
W85-03010

**UNIFIED CULVERT SCOUR DETERMINATION,**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. R. Abt, R. L. Kloberdanz, and C. Mendoza.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1475-1479, October, 1984. 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Culverts, *Scour, *Erosion, Jets, Noncohesive materials, Particle size, Flow discharge.

The ability to predict the magnitude and geometry of scour is useful in the control and management of localized erosion. Experiments were conducted to evaluate how an impinging jet affects the geometry of localized scour in 5 noncohesive bed materials. The resulting data from all tests were dimensionlessly consolidated and the scour dimensions at depth, width, length and volume were correlated to the discharge intensity. A single expression was derived which estimates the dimensions of scour for a variety of noncohesive materials based upon the discharge, culvert diameter, material mean grain diameter and material standard deviation. (Moore-IVI)
W85-03013

**SECONDARY CURRENT AND RIVER-MEANDER FORMATION,**
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 2E.
W85-03035

**LINE MOMENTUM SOURCE IN SHALLOW INVISCID FLUID,**
Hong Kong Univ. Dept. of Civil Engineering.
J. H. W. Lee, and M. D. Greenberg.
Journal of Fluid Mechanics, Vol. 145, p. 287-304, August, 1984. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Water currents, *Jets, *Line momentum, Turbulent flow, Streamflow, Slipstreamlines, Mathematical equations,.

An array of closely spaced, aligned, turbulent, incompressible jets is effectively stimulated by a line momentum source. In a shallow inviscid fluid, such a source induces a predominantly two-dimensional non-diffusive flow which is irrotational except along lines of velocity discontinuity downstream of the source. The flow can be generated by a distribution of line vortices of unknown strength along the unknown slipstreamlines. Based on this vortex model, kinematic and dynamic conditions along the slipstreamlines are formulated and the two resulting nonlinear singular integral equations are solved numerically using a Newton-Raphson-type iterative collocation method. The present results are applicable for multiple weakly buoyant jets into restricted depths, such as cooling water discharges into shallow receiving waters. The success of this theoretical approach suggests extension to the case in which the ambient current is misaligned with the source momentum. The approach suggested avoids the need for an artificial boundary. The flow field demonstrated a marked resemblance to that induced by a nonlinear actuator disk. In the case of no ambient current, experimental results indicate that the slipstreamlines emanate from points which are close to, but not at the ends of, the source. As the ambient current strength increases, a dividing streamline appears in the induced sink flow upstream of the source, and the points from which the slipstreamlines emanate move closer to the ends of the source. Further increases in the current strength result in the smooth blending of this dividing streamline with the slipstreamline. (Baker-IVI)
W85-03038

**PLOTTING POSITIONS FOR PEARSON TYPE-III DISTRIBUTION,**
Yangtze Valley Planning Office, Wuhan (China).
For primary bibliographic entry see Field 2E.
W85-03079

## 8C. Hydraulic Machinery

**PRESSURE AND SOURCE SIZE EFFECTS ON CAVITATION DAMAGE,**
Concordia Univ., Sir George Williams Campus, Montreal (Quebec). Dept. of Civil Engineering.
A. S. Ramamurthy, Y. S. L. Ranganath, and L. B. Carballada.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1490-1494, October, 1984. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydraulic equipment, *Design criteria, *Cavitation, Pressure, Velocity, Cavitation sources.

In hydraulic machinery, cavitation damage can be caused by flow past components such as streamlined guiding surfaces, which act as obstacles to flow. The determination of the velocity exponent, n1, for maximum cavitation damage and the effect of cavitation number on cavitation damage when the source sizes and velocities are fixed are discussed. Studies were conducted in a rotating disk facility which consisted of a circular disk 61 cm in diameter attached to a rotating horizontal shaft (1,800 RPM). To study the effect of source size on damage, equilateral triangular prisms were mounted on the disk to form the cavitating source. The triangular source reduced the large influence of the Reynolds number on the results of damage tests. Maximum caviation erosion appears to be associated with a critical source size when the cavitation number and flow velocity are held constant. Maximum erosion occurs in a narrow band of cavitation numbers. The velocity exponent, n1, had a value of 5.95 and was within the range reported by other investigators. The information presented should be helpful to design engineers of hydraulic machinery. (Baker-IVI)
W85-03014

**ELECTRIC DRIVES - TYPES AND CHOICES,**
C. L. Pattison.
Journal of Institution of Water Engineers and Scientists, Vol. 38, No. 4, p 316-322, August, 1984.

Descriptors: *Pumping plants, *Electric drive systems, Motors, Drive systems, Efficiency, Cost analysis, Maintenance.

In a pumping installation the electrical drive system(s) is usually the largest single plant investment; this is particularly true of variable speed systems when the drive can represent 60% of the total plant costs. Furthermore, the drive system efficiency is one of the major determinants of plant running costs, which when aggregated over the lifetime of the installation, can amount to 90% of the total life cycle costs. Drive systems selection therefore requires careful consideration during project planning and specification, and a decision whether to opt for fixed or variable speed operation is often dominant in the early design stages. The principal requirements of a pump drive system in a modern installation are to minimize energy and manpower costs by optimizing efficiency and creating a reliable maintenance-free operation. Most of the recent significant developments take advantage of modern solid-state devices. (Moore-IVI)
W85-03019

## 8D. Soil Mechanics

**INFLUENCE OF DRAINAGE TRENCHES ON SLOPE STABILITY,**
Zagreb Univ. (Yugoslavia). Faculty of Civil Engineering.
B. Stanic.
Journal of Geotechnical Engineering, Vol. 110, No. 1, p 1624-1636, November, 1984. 9 Fig, 6 Ref, 1 Append.

Descriptors: *Slope stability, *Drainage ditches, *Pore pressure, Groundwater, Earthworks, Shear stress, Landslides, Erosion.

Any slope sliding is a consequence of the equilibrium disturbance between the active and the resisting forces on the critical slip line withing the slope section. An unfavorable groundwater condition is a frequent cause of slope sliding. Pore pressure decreases the effective stress level and consequently the shear stability of the soil on the slip surface is decreased. A change in the groundwater condition is achieved by drainage systems. Drainage trenches are suitable for stabilizing shallow translational slides. The best effect of the drains is achieved when the pore pressures in the failure zone are maximally reduced. A parametric study was undertaken of the spatial influence of drainage trenches on the potential field change in the slope. Using the model developed, the spacing of drainage trenches for slope stability can be determined. The factor of safety obtained represents the long-term value for the steady state condition. The method could be extended to include the time required to consolidate the pore pressure after the drains have been installed. (Moore-IVI)
W85-03098

## 8E. Rock Mechanics and Geology

**DYNAMIC RESPONSE OF DAMS AND OTHER STRUCTURES TO DIFFERENTIAL GROUND MOTIONS,**
A. A. Dumanoglu, and R. L. Severn.
Proceedings of the Institute of Civil Engineers, Part 2, Vol. 77, p 333-352, September, 1984. 13 Fig, 9 Ref.

Descriptors: *Dams, *Design criteria, *Earthquakes, Stress, Dam design, Construction, Hydraulic engineering, Foundations, Bridges.

The effect of an earthquake on a structure depends on its speed of propagation relative to the size of the structure. If the speed is low, as in soft clays, or the structure is large, as with a dam or large bridge, a satisfactory analysis must take into account the finite travel time of the earthquake across the foundation of the structure. The effect of the finite travel time is shown to produce what is called a pseudo-static displacement, in addition to the normal dynamic displacement. Whereas the latter is caused by inertia, the former is caused by the differential movement of the structure-foundation interface, and its determination requires the deformed shape of the structure to be calculated for a given unit displacement of each point, or region, of the interface connection. Differential base accelerations of a structure caused by earthquakes may be categorized as either asynchronous or multiple-support, but in numerical form the same approach relates to both. The basic difference between common and differential base acceleration is that the latter requires the calculation of vectors of displacement which describe the shape which the structure takes up due to unit movement of each of the degrees of freedom which connect the structure to the ground. The distortions are additional to the distortions produced by inertia, and cause additional stresses. These pseudo-static stresses are significant in magnitude for portal frames and three types of dam, and should certainly be taken into account in the design stage. (Baker-IVI)
W85-03053

**MONITORING HYDROGEOLOGICAL CONDITIONS IN FRACTURED ROCK AT THE SITE OF CANADA'S UNDERGROUND RESEARCH LABORATORY,**
Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
C. C. Davison.
Ground Water Monitoring Review, Vol. 4, No. 4, p 95-102, Fall, 1984. 13 Fig, 1 Tab, 9 Ref.

Descriptors: *Powerplants, *Construction, *Geologic fractures, *Nuclear power, *Manitoba, *Canada, Groundwater, Monitoring.

The physical and chemical hydrogeological conditions have been determined for a 2.0 x 10 to the 9th power cubic m volume of fractured plutonic rock surrounding the excavation site of Canada's Underground Research Lab. This information has been used by computer modeling groups to predict the drawdown conditions that will develop at the study area when shaft and underground facilities are excavated. Piezometric and ground water chemistry conditions are being monitored in the rock mass by means of a variety of instruments installed in an extensive borehole array. Conventional water table wells and multiple piezometers have been installed in shallow boreholes to monitor the near-surface hydrogeologic conditions. Deep boreholes have been completed with either a multiple-interval casing system or a multiple-packer/multiple-standpipe piezometer system depending on their diameter. Polyvinyl chloride plastic versions of a mutiple-interval casing system have been installed in 76 mm diameter boreholes shallower than 200 m and stainless-steel versions have been installed in 76 mm diameter boreholes deeper than 200 m. Multiple-packer/multiple-standpipe piezometers have been installed in all of the 152 mm diameter percussion-drilled boreholes at the study area. The data obtained will be compared to computer model predictions to evaluate how well the models, based on pre-excavation data, were able to represent the actual hydrogeological conditions that exist in the large volume of fractured granitic rock surrounding the excavation site. (Baker-IVI)
W85-03180

## 8F. Concrete

**GROUTING REHABS EARTH DAM,**
GKN Hayward Baker Co., Odenton, MD.
For primary bibliographic entry see Field 8A.
W85-02728

## 8I. Fisheries Engineering

**ASSESSING ENVIRONMENTAL IMPACT ON MASS BALANCE, CARRYING CAPACITY AND GROWTH OF EXPLOITED POPULATIONS,**
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen.
Environmental Pollution (Series A), Vol. 36, No. 2, p 133-145, 1984. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Environmental impact statement, *Population dynamics, *Model studies, *Fish management, Fish populations.

Population models that have been applied for assessment of exploited populations are also useful for assessment of environmental impact. Surplus production models have been applied for both fishery and environmental impact assessment. There are three ways that an impact can be introduced into the logistic equation. An impact can affect the mass balance, it can change the coefficient of increase, or it can change the environmental carrying capacity. The properties of logistic surplus production models in which these different impacts are introduced are examined and the results are compared. For each of these possible modes of action the equilibrium relations among biomass, yield, level of fishing and level of environmental stress are developed. The resulting equations are applied to describe the results of lab experiments in which exploited populations were manipulated to alter the growth coefficient, carrying capacity, or mass balance. (Baker-IVI)
W85-03044

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